Presidency or Province and District.	Rainfall for week under report.	State of agricultural prospects.
Rajputana—*contd.*		
Ajmere (Aug. 9th)	Rain throughout district, but insufficient to fill tanks.	Maize slightly damaged in Merwara from rain. Cattle-disease still prevalent. Cholera still in district. Twenty-nine fresh seizures in city and 17 deaths. Prices almost stationary.
Jeypore („ „)	Break in rain	Prospects generally favourable. Few cases of cholera.
Kerowlee . . .	. . . . .	No report received.
Dholepore (Aug. 6th)	Average 5·90	Tanks and wells full. Prospects good. Health good. Prices stationary. Weather seasonable.
Bhurtpore („ 9th)	3·70	Weeding retarded by continual rains.
Ulwar („ „)	Average 7·50	Break much needed. Cholera prevalent in city.
Kotah („ 6th)	1·0	Sporadic cases of cholera, otherwise health good.
Kherwara („ 7th)	1·0	Weather cloudy and misty. Tanks and wells slightly rising. Sun needed for crops. Fever and dysentery somewhat prevalent. Prices slightly risen.
Bickanir („ 6th)	·27; heavier in some districts.	Sowing continue.. Health good. Prices stationary. Weather cloudy.
Nepal—(Aug. 5th)		
Katmandu (Aug. 4th)	3·05	

E. C. BUCK,

Secretary to the Government of India.

GOVERNMENT OF INDIA.

REVENUE AND AGRICULTURAL DEPARTMENT.

WEATHER SUMMARY FOR JULY 1887.

During the month of July the weather over nearly the whole of India has been of the normal monsoon type, but owing to certain abnormal variations in the pressure distribution over Bengal, which will be subsequently referred to, the Bay branch of the monsoon has been weaker and more intermittent than usual, and, as a consequence, those districts dependent on this current for their rain have received a somewhat deficient supply. Indirectly this feebleness of the Bengal monsoon has had a considerable effect on the weather of the Punjab. In that province, experience has shown, abundant rainfall is ordinarily a result produced by the conjunction of the two branches of the monsoon, *viz.*, that from the Bombay Coast and that from the Bay of Bengal. In the present year, owing to the weak and intermittent character of the Bay monsoon, this conjunction seldom or never occurred, and the province has depended for its rainfall on the Bombay current alone. The result has been very deficient rains, except in the south-east of the province and locally at Rawalpindi and Murree. At Peshawar only one shower of rain occurred throughout the month.

The monsoon.—Though less intermittent in character than the Bay branch, the Bombay monsoon has nevertheless exhibited considerable variations. The month opened with unusually weak winds all along the West Coast, but after the 1st an increase of strength commenced. This increase first showed itself on the Sind Coast, and subsequently extended to the Konkan and Malabar Coasts; but it was not until the 5th that the winds reached their normal force. From this date on the West Coast and inland over the Deccan, the Central Provinces, and Central India monsoon winds considerably exceeding the normal strength prevailed until the 19th, when the current became rapidly weaker. This feebleness did not, however, last long, for by the 24th a strong monsoon was again blowing along the whole line of the West Coast from Karachi to Mangalore—a condition which lasted until quite the close of the month.

Over the Bay of Bengal the wind was from south and of about the average strength at the commencement of the month, but the westerly extension of the current was very small, variable winds being reported from the Gangetic Valley. Though by the 2nd moist easterly winds had advanced to Behar and the North-Western Provinces, and by the 3rd had reached the Punjab, the current crossing the Coast had become much lighter, and on the following day had shifted to east-north-east in Bengal and Orissa. On the 5th the normal monsoon winds were entirely interrupted and replaced by light winds feeding into a slight cyclonic vortex forming in the north-west angle of the Bay. These conditions continued during the 6th, but on the 7th the southerly to south-westerly current was restored, and on the 8th was blowing with more than its normal strength. From the 9th to the 15th the winds were generally above the normal force, and a strong monsoon blew across the Bengal Coasts. After the 15th the wind became westerly over a large part of Bengal and the head of the Bay, and the whole of the Bay monsoon was apparently deflected towards the East Coast, whence it spread out over East Bengal, Assam, and Burma. After the 19th more normal conditions set in, and the monsoon current from the Bay was reestablished over a large part of East and South Bengal, and by the 25th a fairly strong monsoon current was blowing up the Bay and across the Bengal Coasts. This was interrupted again on the 27th, when westerly winds were reported from Lower Bengal and the head of the Bay,—conditions which prevailed, with some interruption, till the close of the month.

In the Gangetic plain the monsoon current has been very unsteady. At times a moist south-easterly current from the Bay has prevailed, but during a large part of the month an abnormal westerly and north-westerly wind has been reported over the east of the Punjab and the greater part of the North-Western Provinces, effectually preventing the ingress of the ordinary easterly winds. In the Punjab the wind has been on the whole south-easterly.

Pressure.—Accompanying the north-westerly and westerly winds above mentioned there has been a slight excess of pressure over the eastern districts of the Punjab and the western districts of the North-West Provinces. In all other parts of Northern India there has been a deficiency. Over the Peninsula and the central parts of the country the variations are irregular, but on the whole there has been an excess in the former and deficit in the latter region.

Storms.—The storms which have been observed have generally been slight and have formed over Lower Bengal or the head of the Bay, whence they have travelled slowly in a westerly direction. The first was formed over the head of the Bay on the 3rd, 4th, and 5th, and apparently travelled north-westward into Chutia Nagpur. It occasioned a very slight depression of the barometer, but gave fairly heavy rain to Lower Bengal and Orissa. The second commenced on the 9th over Central Bengal. On the 10th pressure fell rapidly, and the disturbance, the centre of which lay near Burdwan (barometer 29·361″), was much more sharply defined than on the previous day. The chart of the 11th showed the depression near Allahabad, the 12th showed it over Bundelkhand, and the 13th over the north-east of Rajputana, where it filled up. On the day that this depression disappeared, a fresh disturbance was developed over the Sunderbuns with its centre between Calcutta and Saugor Island. This storm advanced in a westerly direction. On the morning of the 14th it lay near Raipur, on the 15th near Hoshangabad, on the 16th near Hyderabad (Sind), and on the 17th had disappeared across the Indus. Between the 19th and 22nd a slight barometric depression existed over the north-west angle of the Bay. On the 24th a small but well defined disturbance was formed between Saugor Island and False Point. This storm travelled north-westward into south-west Bengal on the 25th, to Sutna on the 26th, and to Jhansi on the 27th.

Temperature.—The variations of temperature from the mean have been rather irregular over Northern India. In Assam, Northern Bengal, Behar, and the north-west and west of the Punjab, there is general excess, while elsewhere there is a deficiency. Over the Peninsula and central parts of the country on the contrary there is a deficiency throughout. This deficiency varies between ½° and 1° in Malabar; between ½° and 6° in Bombay; between 1° and 3° in the Berars and Central Provinces; between 2° and 2½° in Guzerat and Central India; between 1½° and 5° in Sind and Rajputana; and between ½° and 2° in Madras. The greatest excess in Northern India is in the Indus Valley, where the mean temperature is 2½° above the average. At Multan and Dera Ismail Khan the mean maximum temperature of the month was 105°.

Humidity is on the whole deficient in Bengal and Malabar, and excessive elsewhere.

Rain.—No rain fell during July over two tracts of country,—the first in the north-west represented by the stations of Dera Ghazi Khan, Multan, Ferozepore, Jacobabad, Shikarpur; the second in the south by Tanjore, Trichinopoly, Madura, and Tuticorin. In the district in the north-west the average rainfall for July is about 3 inches; in the southern district only about 1·5 inches: so that in the former case the deficiency is rather serious; in the latter comparatively unimportant. In all other parts of India rain has fallen. In Northern India, *i.e.*, Assam, North Bengal, the whole country between the north bank of the Ganges and the Himalaya, and over the whole of the Punjab, Sind, and Cutch, the fall has been somewhat deficient. This is likewise the case in Orissa, the Konkan, and the Peninsula, but over the central parts of the country, including Rajputana, the Cis-Gangetic stations of the North-West Provinces, the Central Provinces, Central India, Khandesh, and the Deccan, there has been an excess of rain,—in some districts a very considerable excess. In Lower Burma the rainfall was about 20 per cent. above the average.

The heaviest falls of rain were reported generally from the central parts of the country, where several stations received more than 40 inches during the month. At Jubbulpore between 10 A.M. on the 28th and 10 A.M. on the 29th 13 inches of rain fell.

The following table shows the amount of rain and the difference from the average, during the month of July 1887, according to districts as far as is indicated by the telegraphic reports :

Districts.	Number of Stations.	Average Rainfall for July.	Difference from the Average in July, 1887.
Punjab, West	7	6·16	— 0·75
" East	6	10·23	— 0·36
North-Western Provinces, Trans-Gangetic	14	14·58	— 1·05
" " Cis-Gangetic	7	11·22	+ 3·70
Behar	4	11·20	— 2·80
Northern Bengal	3	19·79	— 5·36
Assam—Cachar	5	16·02	— 6·09
Lower Bengal—Chutia Nagpur	7	14·22	+ 1·88
Orissa—Northern Circars	6	8·70	— 1·09
Central Provinces, South	7	16·58	+ 9·94
Berar—Khandesh	3	7·17	+ 9·12
Rajputana, Central India—Saugor and Narbudda	10	12·94	+ 7·76
Sind—Cutch	3	2·44	— 1·63
Guzerat	4	11·34	+ 1·13
Konkan	4	23·80	— 1·06
Deccan—Hyderabad	8	7·01	+ 1·47
Malabar	5	33·94	— 5·80
Mysore—Bellary	6	2·96	— 0·86
Carnatic	8	2·27	— 1·06
Lower Burma	7	25·19	+ 5·13
Ceylon	2	5·60	— 3·32

W. L. DALLAS,

SIMLA, *4th August 1887.*

for *Meteorological Reporter to the*
Government of India.

GOVERNMENT OF INDIA.

REVENUE AND AGRICULTURAL DEPARTMENT.

Weather Review of India for the week ending the 10th August, 1887.

The general characteristics of the weather in the past week have been the same as those during the period ending August 3rd. The Bombay branch of the monsoon has been of more than the normal strength and extent, while the Bay branch has, on most days, been unsteady and largely deflected towards East Bengal, Assam, and Burma. One feature in the pressure distribution of the present week differs, however, from that of the preceding. A slight but comparatively shallow depression has existed over the Gangetic Valley, and a large portion of the Bombay monsoon current has fed into this area instead of passing across the head of the Peninsula towards the Bay of Bengal.

On the 4th August the Bombay monsoon was blowing with abnormal force along the greater part of the West Coast. From Karrachee to Karwar its direction was westerly and to the south of Karwar north-westerly. It practically extended to all parts of the Peninsula, the Central parts of the country, and the North-West. Though exceptionally strong, the rainfall accompanying it was neither heavy nor extensive. Sind, Kathiawar, Western Rajputana, Western and South-Eastern Punjab, Rohilkhand, and the whole of the Peninsula (except the West Coast) were without rain, and the only places reporting heavy falls were Mount Abu with 3 inches and Nowgong (Central India) with 1½ inches. The chart of the 5th showed little change, except that the monsoon current was slightly weaker. The rainfall area was much the same as that reported on the preceding day, but the amounts were somewhat larger. Slight rain fell along the West Coast districts and across the Deccan to Kurnool, Secunderabad, Cuddapah, and Masulipatam. Over the central districts the fall was also slight, but in the Gangetic plain Lucknow and Fyzabad received 2 inches, Morar 3½ inches, and Dinagepore 4 inches. On the 6th there occurred a further slight decrease in the strength of the monsoon current, but otherwise there was little change; Sind, Rajputana, a large part of Central India, Bundelkhand, the Berars, and the extreme south of the Peninsula, were without rain. Elsewhere precipitation was general, the principal falls being 2 inches at Goa, Gooty, Aligarh, and Allahabad, and Dinagepore 6 inches. On the 7th the Bombay current fell below its normal strength on the West Coast south of Bombay, but to the north of that port it continued to blow strongly. Rain, in moderate amounts, fell generally, except in the west of Rajputana and the Punjab and in Sind and Guzerat. The reports of the following day indicated no change beyond a slight increase of strength in the winds on the West Coast. Seoni received over 5 inches of rain. On the 9th there occurred a further strengthening of the monsoon. It was above its normal strength all along the West Coast, and strong westerly winds prevailed over nearly the whole of India. The principal feature in the rainfall returns was the large increase in the amounts received at the stations within the plain of the Ganges. Allahabad reported 7, Lucknow 4, and Fyzabad 3 inches. These conditions continued during the 10th, when Mirzapore received 5 and Benares and Cawnpore 4 inches of rain.

The Bay of Bengal current has been, as was mentioned above, much less steady than that on the Bombay side. On the 4th this branch of the monsoon was weak and unsteady. Westerly to north-westerly winds prevailed from Bareilly eastward across Behar and Western Bengal, and west-south-westerly winds in Lower and Central Bengal. Normal south-south-easterly winds were reported from Arakan, but elsewhere in Burma the wind was variable. The rainfalls connected with this current were 1½ inches at Moulmein, Dhubri, and Mozufferpore. Chutia Nagpore, South-West and Lower Bengal enjoyed fair weather. On the 5th abnormal westerly winds still prevailed between Bareilly and Purneah, but southerly winds had reappeared on the Bengal Coasts, and extended as far north as Berhampore and Dacca. The rainfall was slightly better, 3 inches falling at Nowgong (Assam) and Dhubri and 2 inches at Darjeeling. The reports of the 6th showed that most of the Bay current was again deflected towards the Arakan Coast, and that in Bengal the wind had veered to South-West. Rain was, however, fairly general, Dhubri receiving 4 and Darjeeling 2 inches. On the 7th the winds at the head of the Bay exceeded their normal strength, but they were generally from South-West, indicating that the Bay current was still deflected towards the East Coast of the Bay. Most of the rainfall was in Assam and Burmah. The chart of the 8th showed that slight cyclonic conditions had been established over the head of the Bay in place of the strong south-westerly winds which prevailed on the 7th. These conditions, slight though they were, occasioned a good deal of ascensional movement over the Bay, and, as a consequence, Chittagong received 8 and Akyab 4 inches of rain. This distribution continued on the 9th, but the resulting rainfall was much slighter. On the 10th south-south-easterly winds appeared in Bengal and easterly winds over Behar and along the foot of the hills to the Punjab. Partly in consequence of this, heavy rainfall was received along the valley of the Ganges and moderate rainfall over nearly the whole of Bengal.

In Upper India the area of rainfall on the 4th was less extensive than it was at the close of the previous week, but Lahore received over 3 inches. On the 5th rain fell over the whole of Upper India to the east of Lahore, but did not extend beyond that station—Delhi received 1, Umballa 2, and Sirsa 3 inches. On the 6th Sirsa again received 3 inches and Delhi ½ inch, but the rain was generally lighter and more scattered than on the previous day. On the 7th rain became heavier again, and moderate to heavy falls occurred from that date till the close of the week.

On the whole the rainfall of the week, except in Upper Sind and the Western Punjab, has been very satisfactory. At Jacobabad there has, as yet, been no rain this season, and at Peshawar only two showers, while at Mooltan and over the south-west of the Punjab generally there has either been no rain or none for several weeks past. For these districts the returns for last week exhibit no improvement, but in other parts of India, as will be seen from the following table, the seasonal rains have, so far, been heavy or merely slightly deficient;

Stations.		Total Rainfall since June 1st, 1887.	Average Rainfall, June 1st to August 10th.	Difference.
Akyab	...	85·40	110·33	—24·93
Saugor Island	...	33·53	33·56	— 0·03
Calcutta	...	30·11	29·46	+ 0·65
Dhubri	...	39·77	43·51	— 3·74
Purneah	...	28·43	31·53	— 3·10
Gya	...	22·88	22·27	+ 0·61
Allahabad	...	24·56	20·78	+ 3·78
Meerut	...	11·56	13·27	— 1·71
Delhi	...	23·75	12·79	+ 10·96
Lahore	...	9·76	8·78	+ 0·98
Peshawar	...	0·86	3·36	— 2·50
Cochin	...	49·89	63·30	—13·41
Ratnagiri	...	74·53	72·63	+ 1·90
Bombay	...	59·13	48·59	+ 10·54
Poona	...	15·70	14·02	+ 1·68
Surat	...	33·16	24·80	+ 8·36
Khandwa	...	20·83	18·70	+ 2·13
Nagpur	...	31·63	24·67	+ 6·96

The weather during the past week has been cooler than the average throughout almost the whole of India. In the North-West Provinces and Central India the defect of temperature amounted to 4°, in the Punjab, the Central Provinces, and Rajputana to 3°, and elsewhere to between ½° and 2°. In the Indus Valley there was a local excess of temperature,—greatest at Mooltan, where it amounted to 2½°.

The concluding table gives the total rainfall of the past week for the different Provinces:

Divisions.		No. of Stations.	Total Rainfall.
Burmah	...	6	37·20
Bengal and Assam	...	16	81·93
North-Western Provinces and Oudh	...	9	45·55
Punjab	...	6	26·20
Hill Stations	...	5	27·13
Ceylon	...	2	3·19
Malabar Coast	...	5	6·76
Bombay	...	9	18·74
Berars and Central Provinces	...	10	28·40
Guzerat and Central India	...	6	8·75
Sind—Rajputana	...	4	13·08
Madras	...	13	18·10

W. L. DALLAS,

SIMLA, *12th August, 1887.* for *Meteorological Reporter to the Government of India.*

E. C. BUCK,

Secretary to the Government of India.

GOVERNMENT OF INDIA.

PUBLIC WORKS DEPARTMENT.

RAILWAY TRAFFIC.

No. XIV OF 1887-88.

APPROXIMATE STATEMENT OF GROSS RECEIPTS AND EXPENSES OF INDIAN RAILWAYS.

N.B.—As regards the figures in column *Total Receipts from 1st April to date*, audited figures have been used, as far as possible

Latest Return received.	RAILWAYS.	Total mean length open.	RECEIPTS FOR WEEK ENDING 10TH JULY, 1886.		Total mean length open.	RECEIPTS FOR WEEK ENDING 9TH JULY, 1887.		TOTAL RECEIPTS FROM 1ST APRIL, TO 10TH JULY, 1886.		TOTAL RECEIPTS FROM 1ST APRIL, TO 9TH JULY, 1887.		Total increase in 1887-88.	Total decrease 1887-88.
			Total.	Per mile open.		Total.	Per mile open.	Total.	Per mile open per week.	Total.	Per mile open per week.		
	Lines worked by Guaranteed Companies.		*Rs.*	*Rs.*		*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*	*Rs.*
16th July, 1887	Oudh and Rohilkhand	680	1,00,005	147	686	89,425	130	21,40,725	218	20,10,115	205	...	1,30,6
23rd July, 1887	Madras	801	1,50,563	175	831	1,48,587	179	22,09,454	178	22,99,214	194	89,760	...
Ditto	South Indian	654	1,03,347	158	654	1,07,317	164	14,73,991	150	14,74,874	158	883	...
Ditto	Great Indian Peninsula	1,497	5,13,793	343	1,497	5,03,001	336	1,29,38,917	599	1,43,95,002	673	14,56,085	...
Ditto	Bombay, Baroda and Central India	461	1,60,722	368	461	1,30,000	282	47,63,742	716	43,86,336	666	...	3,77,406
	TOTAL	4,153	10,37,430	250	4,129	9,78,330	237	2,35,26,829	393	2,45,65,541	416	10,38,712	...
	State Lines worked by Guaranteed Companies.												
30th July, 1887	East Indian	1,515	7,58,534	501	1,519	7,92,935	522	1,38,67,200	634	1,34,77,961	621	...	3,89,239
Ditto	Patna-Gya	57	7,307	128	57	8,350	146	1,37,126	167	1,30,888	161	...	6,238
Ditto	Dildarnagar-Ghazipur	12	748	61	12	784	65	18,313	106	15,337	89	...	2,976
Ditto	Sindia	75	5,950	79	75	7,016	94	1,04,875	97	1,23,812	115	18,937	...
23rd July, 1887	Rajputana-Malwa (*a*)	1,664	2,70,224	162	1,664	2,16,000	130	56,68,841	236	51,24,191	215	..	5,44,630
Ditto	Southern Mahratta	315	30,433	96	674	57,061	86	5,01,609	110	9,16,641	101	4,15,032	...
30th July, 1887	Indian Midland	42	1,593	38	42	2,661	63	28,387	47	50,030	93	27,643	...
23rd July, 1887	Lucknow-Sitapur-Sihramau	...	...	...	85	3,739	44	...	...	60,231	52	60,231	...
	TOTAL	3,680	10,74,769	292	4,128	10,89,446	264	2,03,26,351	383	1,99,05,091	341	...	4,21,260
	State Lines worked by Government.												
23rd July, 1887	Eastern Bengal (*b*)	606	96,554	159	645	1,12,003	175	19,81,375	226	19,21,198	208	...	60,177
Ditto	Nalhati	27	1,275	47	27	1,738	64	26,158	67	27,104	70	946	...
Ditto	Tirhoot	246	27,984	114	249	28,344	114	4,88,104	137	5,10,182	143	22,078	...
Ditto	Wardha Coal	45	13,233	294	45	13,931	310	2,15,636	332	2,32,924	302	17,288	...
Ditto	Bengal-Nagpur (late Nagpur-Chhattisgarh)	149	14,275	96	149	11,237	75	5,22,067	243	5,04,485	238	...	17,582
16th July, 1887	Burma	327	32,582	99	327	40,800	143	6,59,687	140	8,60,802	184	2,01,115	...
Ditto	Cherra-Companyganj	...	...	...	7	20	3	...	..	640	0	640	...
Ditto	North-Western (*c*)	1,869	4,78,926	256	2,078	3,78,439	182	74,05,524	275	62,22,957	209	...	11,82,567
23rd July, 1887	Bareilly-Pilibheet	36	1,917	53	36	1,404	39	32,001	63	27,952	54	...	4,049
16th July, 1887	Jorhat	26	850	33	26	1,124	43	9,580	26	13,465	36	3,885	...
23rd July, 1887	Bilaspur-Etawa (Katni-Umaria Section)	...	...	...	38	1,462	39	...	...	20,924	38	20,924	...
	TOTAL	3,331	6,67,596	200	3,627	5,97,492	165	1,13,40,732	236	1,03,42,633	199	...	9,98,099
GRAND TOTAL (GUARANTEED AND STATE)		11,164	27,79,795	249	11,884	26,65,268	224	5,51,93,912	343	5,48,13,265	324	...	3,80,647
GROSS ESTIMATED EXPENSES		...	...	...	...	...	...	2,52,38,899	157	(*d*) 2,50,19,522	148	...	...
NET RECEIPTS		...	...	...	...	...	...	2,99,55,013	186	2,97,93,743	170	...	1,61,270
	Assisted Companies.												
23rd July, 1887	Bengal Central	125	8,490	68	125	10,035	87	1,87,686	104	1,78,255	100	...	9,431
Ditto	Rohilkhand-Kumaon	67	5,561	83	67	6,098	91	1,03,517	107	1,05,312	110	1,795	...
16th July, 1887	Dibru-Sadiya (late Assam)	78	4,010	51	78	8,967	115	93,884	83	1,22,561	110	28,677	...
Ditto	Bengal and North-Western	303	41,168	136	376	34,665	92	6,49,105	148	6,84,794	127	35,689	...
30th July, 1887	Tarakessur	22	4,880	222	22	5,799	264	79,704	251	82,189	261	2,485	...
	TOTAL	595	64,109	108	668	66,464	99	11,13,896	130	11,73,111	123	59,215	...
	Native States.												
23rd July, 1887	Bhavnagar-Gondal	193	11,703	61	193	12,852	67	3,66,034	131	3,75,067	136	9,033	...
Ditto	Jodhpore	64	2,784	43	124	5,500	44	57,857	63	1,05,846	60	47,989	...
Ditto	Nizam's	208	21,950	100	208	22,978	110	3,72,635	124	4,63,139	156	90,504	...
Ditto	Mysore	140	8,662	62	140	9,280	66	1,24,104	61	1,38,908	69	14,804	...
16th July, 1887	Rajpura-Patiala	10	683	43	16	880	55	18,896	82	15,676	69	...	3,220
23rd July, 1887	Morvi	24	371	15	68	2,228	33	17,265	50	46,994	48	29,729	...
	TOTAL	645	46,153	72	749	53,718	72	9,56,791	103	11,45,630	107	1,88,839	...

(*a*) Includes the Cawnpore-Achnera State Railway.

(*b*) Includes the Northern Bengal, Dacca, Kaunia-Dharlla, and Assam-Behar State Railways.

(*c*) Includes the Amritsar-Pathankot State Railway.

(*d*) Calculated on percentage used for the corresponding period of 1886.

SIMLA,
The 11th August, 1887.

JAMES RAMSAY,
Offg. Under Secretary.

Printed and published for the GOVERNMENT OF INDIA *at the* GOVERNMENT CENTRAL PRESS, *Simla.*

SUPPLEMENT TO

The Gazette of India.

No. 34.} CALCUTTA, SATURDAY, AUGUST 20, 1887.

OFFICIAL PAPERS.

A SUPPLEMENT *to the* GAZETTE OF INDIA *will be published from time to time, containing such Official Papers and information as the Government of India may deem to be of interest to the Public, and such as may usefully be made known. The Debates of the Legislative Council of His Excellency the Governor General will in future be published in* PART VI *of the* GAZETTE.

Non-Subscribers to the GAZETTE *may receive the* SUPPLEMENT *separately on a payment of five Rupees per annum if delivered in Calcutta, or eight Rupees if sent by Post. The* SUPPLEMENT *and* PART VI *of the* GAZETTE *can also be subscribed for separately on a payment of Rupees six per annum if delivered in Calcutta or Rupees nine if sent by Post.*

No Official Orders or Notifications, the Publication of which in the GAZETTE OF INDIA *is required by Law, or which it has been customary to publish in the* CALCUTTA GAZETTE, *will be included in the* SUPPLEMENT. *For such Orders and Notifications the body of the* GAZETTE *must be looked to.*

GOVERNMENT OF INDIA.

PUBLIC WORKS DEPARTMENT.

Railway Construction.

PROJECTED RAILWAY FROM MOGHALSARAI TO PURI.

No. 799 R. C., dated Simla, 12th August, 1887.

RESOLUTION—By the Government of India, Public Works Department.

READ the following papers:—

Resolution of the Government of India, No. 862 Ry. Constn., dated 24th Sept. 1883.
Ditto No. 73 do. „ 29th Jan. 1884.

RESOLUTION.—The desirability of utilising the Palamow coal-field for the supply of the Railways to the north-west of Moghalsarai has been for many years recognised, and surveys with this object were made between that field and Baroon, the head of the Sone canal system, in the year 1876-77. In the course of the investigation regarding railway construction throughout India which took place in 1882, however, it became evident that a larger project was required, which would afford an outlet to the east, as well as the west, for the mineral and agricultural produce of the large province of Chutia-Nagpur, and also that such a project might, with the intervention of the contemplated Nagpur-Sitarampur Railway, be extended to Cuttack and Puri, so as to aid by railway transit the vast number of pilgrims who annually visit the latter place, and to afford to the province of Orissa, by direct access from the food-supply of Chhatisgurh, an effective protection against famine. The substantial objects of this project have also been well described as (1) to provide a quick and easy means of travelling for the army of pilgrims who visit the shrines of Benares, Gaya and Puri; (2) to open out the resources of large and important tracts of country now almost cut off from communication with the rest of India, to supply them with food if scarcity prevails, or to carry it to other districts if a surplus is available; and (3) to facilitate emigration from overcrowded districts to those which are but sparsely inhabited, yet capable of supporting a very considerable increase of population.

2. In the autumn of 1882, the Government of India consequently ordered the commencement of a series of surveys which have been carried on up to the past year, and have embraced all the more promising alternative routes between Benares and Puri.

The result of these investigations has been to establish the fact that the project practically resolves itself into two portions: the one providing for the development of Chutia-Nagpur, and aiding the coal supply of Upper India, the other securing the famine protection of Orissa, and the opening out of the portions of the Central Provinces and Bengal traversed by the line, but both possessing the object and common interest of facilitating transit of pilgrims to Puri. The two portions become, in fact, separate Railways linked by a section of the Bengal-Nagpur Railway now under construction, and by a common interest, but free to be constructed by one and the same, or by two totally distinct agencies. The principal features of each of these portions of the project will now be briefly described.

Chutia-Nagpur Railway.

3. *Moghalsarai to Sukhua*—(Palamow Coal-fields) 147½ miles. The original project for opening out these coal-fields started from Meral, and proceeded *viâ* Bhikhee, Chutterpore, Sultance, Maharajgunj and Kutumbeh to Baroon on the river Sone, which is at the head of the Patna Canal, and opposite Dehree, whence starts the Buxar Canal. A western route to Baroon, *viâ* Kunda Khas, Chutterpore, Burdag and Nubeenuggur, as also sundry minor variations of both routes, were examined and condemned. This route, however, was deemed unsuitable for the larger scheme originated in 1882, on account both of the heavy cost of crossing the Sone in the locality of Baroon, and of the expediency of opening out the country farther west, if possible. Reconnaissances made in the spring of 1883 resulted in the selection of a line running from Moghalsarai *viâ* the Kaimur plateau and Ghaggar river to the Sone at Urgurh, and thence, after crossing the river at Hardi, to Chapparbar, Gurwa and Daltongunj. In the following season, a preferable route was found over the Vindhya plateau, passing east of Bijaygurh to a crossing of the Sone at Parcha, but the latter crossing led to the proposal of an alternative which, after running along the banks of the Sone to Tilotu, should surmount the narrow hills about four miles west of Sasseram and then go direct to Moghalsarai. The Government of the North-Western Provinces and Oudh, while recognising that the former would open out an undeveloped locality, held that the latter must be deemed preferable, since it would be much cheaper, it would traverse a richer tract of country, and its far better gradients would facilitate the cheap transit of coal. In this conclusion the Government of India concurred, and the section from Moghalsarai has been located and estimated accordingly to Sukhua, a place close to Meral, in the centre of the coal-field, whence the branch line to Gaya will take off.

A suggestion has been made that the line might be shortened greatly by proceeding direct from the coal-field to the Sone, and facing the difficulties of a large bridge there, to the cost of which the saving by less distance and avoiding a bridge over the Koel would be a material set off. This suggestion might be investigated whenever the railway was taken in hand, but there would probably be found a material drawback in the loss of traffic from Gurwa and the country to the south of it.

4. *Sukhua to Rud*—50 miles. This section presents no very remarkable features, being partly easy and partly through hilly and broken country, with gradients of 1 in 100. The location runs for about 15 miles through the Aurunga coal-field.

5. *Rud to Purulia*—110½ miles; with branch, 50 miles long, from mile 275½ (near Jhalda Station) to Chandel.

The question of which route from the locality of Rud in the direction of Cuttack would best accommodate the various interests involved has been found to be the most complicated of any which have arisen.

In 1882 and 1883 it was understood to be necessary to traverse the plateau of Ranchi in order to develop it. The best information then obtainable shewed that a line running directly southwards to the locality of Suadi or Laingurh, on the Bengal-Nagpur Railway, would pass through difficult mountainous country very sparsely inhabited. A route in a more south-easterly direction was consequently deemed necessary. In the seasons of 1883 and 1884 several lines were examined for ascending the plateau, that by the Mahlan Ghat being eventually selected. After crossing the plateau, unsuccessful attempts were made to descend direct upon the locality of Chakardarpur and Chaibasa, by the Ghâts in the direction of Bandgam, and eventually a line by Pirihati and Aruki to Chandel, a station much farther north on the Bengal-Nagpur Railway, was alone found to be suitable.

In 1884, however, an opinion which had originally been offered in 1882 by Mr. H. H. Risley, B.C.S., that the plateau of Ranchi could be as effectively and more cheaply served by a railway passing along its northern base through the valley of the Damuda than by one surmounting the plateau itself, was exhaustively discussed, with the result that the alternative line through the valley was surveyed in 1884-85, and is now recognised by both the Government of Bengal and the Government of India as the more suitable of the two. This valley line traverses the Kurunpura coal-field, and also is expected to receive traffic from parts of the Hazaribagh District. At the same time the importance and capacity for development of the Chutia-Nagpur traffic has brought into prominence the necessity that the Damuda Valley line should leave the Chandel route near Jhalda station, and join the Bengal-Nagpur Railway at Purulia, instead of at Chandel, so as to afford the nearest transit to Calcutta. This will shorten the line by 16½ miles, in the first instance, but pilgrims from Benares to Puri will thereby have to make a detour of about 15 miles. This may eventually be avoided, if their numbers should hereafter develope sufficiently to warrant the construction, as a chord alternative, of the portion of the Chandel route (50 miles long) which will thus in the first instance be discarded.

6. *Gaya Branch*—80 miles. A connection between Gaya and the locality of Daltongunj has been from the first accepted as an indispensable accessory to the main project, because of the goods traffic which may reasonably be expected, and also of the pilgrims who would pass on from Gaya to Puri in the course of the normal round of sacred places to be visited. Three routes have at various times been examined, *viz.*, an easterly one from Tori by Chutra, another to the west by Chutterpore, and an intermediate one by Manatu, the valley of the Mohur and Sherghati. The last of these has been approved.

7. *Total cost.*—The cost of the Chutia-Nagpur Railway* has been estimated as follows :—

	Miles.	Direct charges. Lakhs.	Indirect, including exchange at 1*s.* 6*d.*	Total.
Section I Moghalsarai—Sukhua	147½	170	14½	184½
„ II Sukhua—Rud	50	46½	4¾	51¼
„ IIIa. Rud—Jhalda	77½	83½	6½	90
„ IIIb. Jhalda—Purulia	33	32½	2½	35
TOTAL MAIN LINE . .	308	332½	28¼	360¾
Gaya Branch	80	69	6	75
GRAND TOTAL . .	388	401½	34¼	435¾

The estimates of the line from Moghalsarai to Chandel have been examined by Mr. Molesworth, the Consulting Engineer to the Government of India, with the result that, while some items are increased or reduced, the total is increased by only about a lakh of rupees. His note is appended.

8. *Probable Traffic.*—It is impossible to present any definite and reliable estimates on this subject in respect of a large tract of country which at present is to a great extent land-locked, unable to export except along country roads and paths, by means of carts and pack bullocks, and for the most part devoid of effective stimulus to production. Various estimates of produce and returns will be found among the papers appended to this Resolution; but while they appear for the most part to have been framed with extreme caution, it is impossible to predicate to what extent, if at all, they are likely to be exceeded, and any attempt to do so might only prove misleading. The Government of India are unable to say more than that the coal and other mineral resources of Chutia-Nagpur have been described in the geological writings of Dr. Ball, Dr. Oldham, Mr. Hughes, and others, as also in recent articles in the *Indian Engineer*; that the trade has been analysed, with much care and local knowledge, by Mr. H. H. Risley, of the Bengal Civil Service, whose note is appended; and that the pilgrim traffic is an important factor, the extent or expansion of which it is equally difficult to ascertain and to foresee.

---

* The Jhalda-Chandel Branch, 49½ miles long, estimated at 58¼ lakhs, is not added, as the probability of its being required appears to be remote.

Panchpara-Puri Railway.

9. *Panchpara to Naraj*—170 miles. For the upper portion of this section various lines have been surveyed, the result being that it is found to be on the whole desirable to take the line close to the town of Sambalpur. Running thence to the southward, a route passing through Gopalprasad in the centre of the Talcher coal-field, and Denakal, the most considerable town in those parts, has been preferred to a more westerly one *viâ* Angul. This route will be convenient for the Bamra State, which is reported to be "rich in timber and iron, and capable of great development."

10. *Naraj to Puri*—52 miles. Naraj has been selected as the point for crossing the Mahanadi, because the river here is suitable for either a ferry or a bridge of 3,250 running feet, and the continuation to Puri presents no difficulties. At Cuttack, on the contrary, the bridging of the Mahanadi, which is a mile and a half wide, is practically out of the question, and moreover, supposing the town had been reached, there would remain another channel to the south, called the Katjori, which would need a bridge of 3,000 feet, or nearly equal to the one sufficing at Naraj. At Naraj, a ferry might be adopted in the first instance, leaving the bridge, which is estimated at about 22½ (or 33) lakhs, to follow whenever the traffic was found to justify it.

11. *Cuttack Branch.*—It is by no means certain that any further facilities are needed for the town of Cuttack than those which will be afforded by the main line passing Naraj, within a few miles of it. But should such be hereafter demanded, a branch line might be made from that line either on the north of the Mahanadi, to opposite the town, or on the south to the southern side of the Katjori, a ferry in either case completing the communication. The Katjori ferry, however, would hardly be workable during the rains. The distance in the former case would be 8½ miles, and in the latter 6 miles; the cost in either about one lakh per mile. Mr. Molesworth, the Consulting Engineer to the Government of India, has, however, suggested, in a note which is appended, that the line between Naraj and Puri might be taken direct instead of *viâ* Khurda, by which improved gradients would be obtained, distance saved, and possibly a separate branch to Cuttack avoided altogether. The question depends mainly upon the exigencies of local traffic, which would be very large, and needs further investigation in communication with the local authorities.

12. Keonjhur alternative.—An account of the Panchpara-Naraj project would be incomplete without some notice of the alternative route *viâ* Keonjhur originally investigated. This route, starting from Kantera (on the Bengal-Nagpur Railway) which is in the vicinity of Chakardarpur, would obviously have been very direct, if a suitable line across the Ranchi plateau could have been brought to the same locality, as at one time anticipated (*supra*, paragraph 5) and the Keonjhur and Mohurbunj tract which it would traverse was believed to be fertile and known to have been more populous in former days. The reconnaissances of 1884 and 1885, however, shewed that the engineering difficulties were far more formidable, but the capabilities of the country less, than had been anticipated. The ascent and descent of the plateau involved expensive work, there was much difficult country and several rivers, one of which, the Brahmini, required a bridge 5,400 feet in length, and costing 32½ lakhs of rupees, and the cost of working would permanently be high. The abandonment of the route thus became unavoidable. The Panchpara-Naraj route, which has been substituted for it, will involve some extra miles of journey to pilgrims from the eastward, but a corresponding gain to those who come from Western, Central and Northern India.

13. *Total cost.*—The cost of the Panchpara-Puri Railway has been estimated as follows:—

	Miles.	Direct charges. Lakhs.	Indirect, including Exchange at 1-6.	TOTAL.
Section I.—Panchpara-Naraj	170	144⅛	9⅞	154
" II.—Naraj-Puri with ferry	52	56⅞	4⅜	61¼
TOTAL MAIN LINE .	222	201	14¼	215¼
" III.—Mahanadi Bridge	...	22½	¾	23¼
TOTAL MAIN LINE, WITH BRIDGE .	222	223½	15	238½
" IV.—Cuttack Branch, Northern alternative .	8½	7½	½	8
GRAND TOTAL .	230½	231	15½	246½

It has already been explained that neither the Mahanadi Bridge nor a Cuttack Branch are indispensable, and may stand over until called for by experience.

The estimates have been examined by Mr. Molesworth, whose note is appended. He would increase the main line from 201½ to 208½ lakhs, the bridge from 22½ to 33 lakhs and the branch by a lakh. But the adoption of his suggestion, above alluded to, as to running direct to Puri and dispensing with a branch might go far to reduce this excess.

14. *Probable traffic.*—The general remarks which have been made in paragraph 8 with respect to the Chutia-Nagpur Railway may be applied to this case also. The capabilities of an undeveloped country can be but imperfectly appraised by statistics of existing traffic. The goods traffic between Sambalpur and Cuttack appears to be by no means inconsiderable, notwithstanding the absence of roads, and will be subject to large temporary influxes whenever scarcity of food grains may exist in Orissa, while the pilgrims are believed by the local authorities to be not fewer than 300,000 per annum. The opinions of the local authorities as to the prospects of development are unanimously favourable. That so large a number of persons should present themselves at Puri annually notwithstanding the obstacles presented by the journey, whether by land or sea, the ravages of cholera and other diseases on the former, and the risk of shipwreck (just fatally illustrated) on the latter, may well excite surprise, and justify anticipations of what the facilities of railway transit might produce.

General Remarks.

15. While thus putting forward, with the general approval of the Government of India, the two distinct lines constituting the Benares-Puri Railway project, which have been described above, it is necessary to state briefly, with reference to the remarks in paragraph 5 as to the difficulties of a direct line from the Palamow coal-fields to the locality of Suadi or Laingurh on the Bengal-Nagpur Railway, that reconnaissances made in 1886 may be held to shew that these are not so formidable as were supposed. Between Panchpara on the Bengal-Nagpur Railway and Sathbarwa station near Palamow on the Chutia-Nagpur line, the distance is reported to be 178 miles, and the cost is very roughly estimated at 189 lakhs of rupees. The gradients, however, are very steep in some parts, and the population undoubtedly scanty. This route was recommended to the consideration of the Government of India by the Government of Bengal, with the suggestion that, supposing its directness were considered to give it the preference as a means of communication between Northern India and Puri, the construction of the Palamow-Gaya line might perhaps suffice for present requirements, leaving for future development the question of a connection between the coal-fields and Moghalsarai—possibly from Shergotty, with a bridge over the Sone, and through Sasseram.

After fully considering the matter, and even assuming that the Panchpara-Palamow line might prove far less expensive and more profitable than it has been shewn to be, the Government of India entirely concur with the final opinion of the Hon'ble Sir Steuart Bayley, expressed in the Bengal Government letter No. 1108R. of 17th May last, that by such a line, running north and south, the important object of opening out [illegible] pilgrim traffic derivable from Benares Provinces [illegible] and the market for coal presented in that direction would both be sacrificed. The Chutia-Nagpur Railway project, as described in this Resolution, is in complete harmony with the views of His Honor, as expressed in that letter.

16. With regard to the estimates which have been put forward in paragraphs 7 and 13, it may be explained that these are in all cases the result of carefully located surveys accompanied by plans, sections and detailed drawings of bridges, buildings, &c., upon a large scale, and estimates framed upon the best information available at the time. The former, however, must necessarily be considered as subject to the detailed scrutiny which would precede actual operations, and the latter, framed at different, and not always very recent dates, may in many particulars not be in conformity with present rates of labour, or prices of iron and steel. Exchange has been applied at a uniform rate of 1s. 6d. Under such circumstances, the results presented cannot be deemed to be more than a general indication of probable operations and cost, and no definite responsibility on their account can attach to the Government of India.

17. In conclusion, the Governor-General in Council has much pleasure in recognising the zeal, ability and fortitude with which these extensive surveys have been prosecuted, for a period of four years, in an extremely difficult and for the most part unhealthy country. To Mr. W. H. Parker, who held the post of Engineer-in-Chief throughout the whole of the active operations, thanks are specially due for the ability, tact, and perseverance displayed, amongst the officers of his staff, Captain Laugharne, R.E., and Mr. Von. Ahn, Executive Engineers, and Mr. W. E. Newham, and Mr. E. T. Faulkner, Assistants, have been specially distinguished; Mr. F. J. E. Spring, Executive Engineer, and Mr. E. C. Hawkes, Temporary Engineer, as also Messrs. G. Deuchars, and Monson, and C. Warde, Assistants, are deserving of praise; Messrs. J. M. Chabrel and E. J. McCudden also did good service.

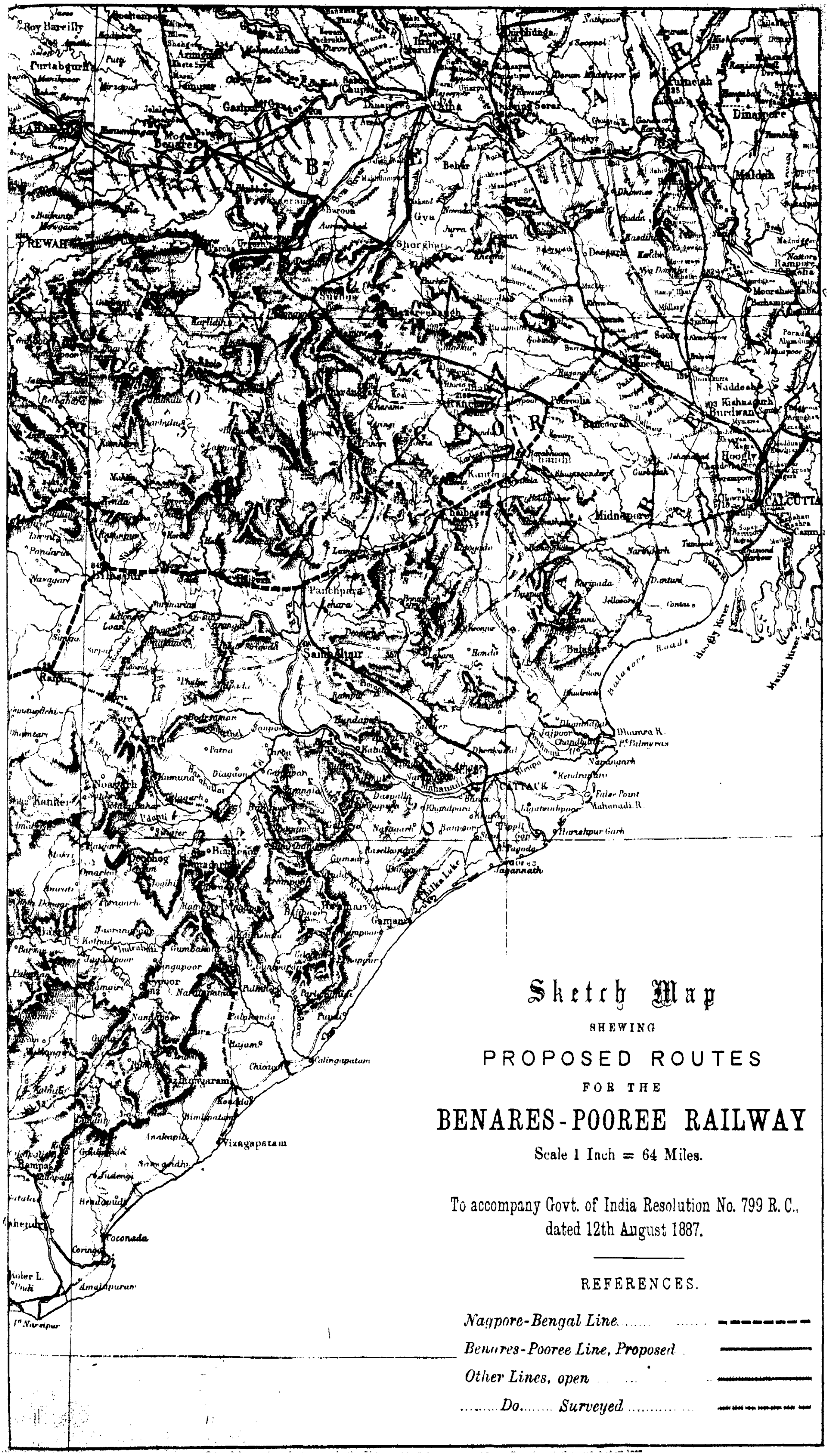
Mr. T. Owen officiated as Engineer-in-Chief during the latter half of 1886, and submitted the final report and estimates.

ORDER.—Ordered that this Resolution, together with the Index Map and documents specified below, be communicated to the Governments of Bengal and the North-Western Provinces and Oudh, and the Chief Commissioner, Central Provinces, and published in the Supplement to the *Gazette of India* for general information.

R. C. B. PEMBERTON, *Colonel, R.E.,*
Secretary.

DOCUMENTS ACCOMPANYING.

1. Index Map.
2. Note by Mr. H. H. Risley on the trade of Chota Nagpore, dated 15th May 1882.
3. Letter to the Government of Bengal, No. 1080 R. C., dated 16th December 1882.
4. Mr. Parker's Report on the Gaya Branch, August 1884.
5. Letter from the Government, North-Western Provinces and Oudh, No. C. 150 W. R., dated 17th September 1884.
6. Mr. Graves' Report on the Garwa-Rud Section, 1883-84.
7. Captain Laugharne's Report on the Moghalsarai-Palamow Section, 1884-85.
8. Mr. Hawkes' Report on the Rud-Ramgarh Section, 1884-85.
9. Mr. Chabrel's Report on the Ramgarh-Chandel Section, 1884-85.
10. Report on alternative from mile 275 to Purulia.
11. Mr. Parker's Report, 1884-85, paragraphs 10—33.
12. Report by Mr. A. Smith, Commissioner of Orissa, No. 516, dated 14th April 1883, paras. 2, 13, 15—17, 19, 53—56.
13. Letter from Government of Bengal, No. 22 R. T.-R., dated 29th August 1883.
14. Letter from Chief Commissioner, Central Provinces, No. 13C., dated 31st December 1884, with enclosure.
15. Note by Mr. W. H. Parker, Engineer-in-Chief, Benares-Puri Railway Survey, dated 18th August 1885.
16. Note by Mr. J. B. Fuller, Commissioner of Settlements and Agriculture, Central Provinces, dated August 1886.
17. Report by Mr. C. T. Metcalfe, Commissioner of Orissa, No. 424, dated 27th February 1886.
18. Note by Mr. W. H. Parker, Engineer-in-Chief, Benares-Puri Railway Survey, dated June, 1886.
19. Report by Mr. T. Owen, Officiating Engineer-in-Chief, Benares-Puri Railway Survey, paras. 3—7.
20. Do. do. No. 567, dated 13th November 1886, with enclosures.
21. Abstract Estimates I. Moghalsarai to Sukhua.
23. „ „ II. Sukhua to Rud.
24. „ „ IV. Rud to Chandel.
25. „ „ V. Mile 275 (Jhalda) to Purulia.
26. „ „ VI. Gaya to Sukhua.
27. „ „ VII. Panchpara to Naraj.
28. „ „ VIII. Naraj to Puri, including ferry.
29. „ „ IX. Naraj to Puri, including bridge.
30. „ „ X. Cuttack Branch.
31. Letter from Government of Bengal, No. 623 R., dated 30th March 1887.
32. „ „ No. 1108 R., dated 17th May 1887.
33. „ „ No. 48 T.-R., dated 27th June 1887.
34. Note by Mr. G. L. Molesworth, C.I.E., on the estimates, Moghalsarai to Chandel.
35. „ „ „ Panchpara to Puri.
36. Memorial by the Orissa Association, dated 16th July 1887.



Sketch Map

SHEWING

PROPOSED ROUTES

FOR THE

BENARES-POOREE RAILWAY

Scale 1 Inch = 64 Miles.

To accompany Govt. of India Resolution No. 799 R. C.,
dated 12th August 1887.

REFERENCES.

Nagpore-Bengal Line
Benares-Pooree Line, Proposed
Other Lines, open
.........*Do*........ *Surveyed*

Enclosure No. 2 to Railway Resolution No. 799 R.C. of 1887.

Note by H. H. Risley, Esq., C.S., Asst. Commr. of Manbhoom, on the trade of Chota Nagpore,—dated 15th July 1882.

Object of this note.

An attempt is made in this note to indicate, so far as existing materials permit, the general character of the export and import trade of the Chota Nagpore Division, the marts at which it is collected, and the routes by which it is conveyed. Some of the figured estimates, which have been made at various times, of the quantity and value of portions of this trade will be reproduced and examined, and it will be shown that, with one trifling exception, such estimates are purely conjectural, and furnish no trustworthy data for a forecast of the probable traffic on the proposed railway from Sitarampore on the East Indian Railway to Nagpore in the Central Provinces. With the through traffic, which may be looked for between the Central Provinces and Calcutta, I shall not attempt to deal; nor shall I concern myself with *local* trade, properly so called, between places situated within Chota Nagpore.

Character of the country.

Tributary States.

2. The Chota Nagpore Division is a pear-shaped tract of hilly and undulating country, forming three successive steps from the highlands of Central India to the alluvial plains of Bengal. On the extreme west of the Division, the Tributary States, a confused mass of hills, ravines and plateaux, project like a wedge into Rewa and the Central Provinces, sending off streams on the north towards the Sone and the river system of Behar, and on the south towards Orissa and the Bay of Bengal. It is believed that, at a remote geological period, the entire country now included in the Tributary States formed a uniform table-land, elevated about 3,600 feet above the sea. Traces of such a state of things are to be found in the flat-topped hills, locally known as *páts*, several of which mark the descent from the State of Sirgoojah into the British District of Lohardugga.

Lohardugga District.

3. The District of Lohardugga, forming the central and north-western portion of the Division, comprises two tracts of country, which differ essentially in aspect and physical conformation—Chota Nagpore Proper, and the Sub-Division of Palamow. Chota Nagpore Proper, as distinguished from the Commissioner's Division bearing that name, is an elevated table-land situated about 2,100 feet above the sea, and occupying the central and south-eastern portion of Lohardugga District. On the north-west, the table-land falls away into the Sub-Division of Palamow, which extends on the north to Behar and the Mirzapore District of the North-West Provinces. On the east and south, Palamow consists of spurs thrown off from the plateaux of Hazaribagh and Chota Nagpore Proper, while the rest of the Sub-Division is a tangled mass of isolated peaks and long irregular stretches of broken hills. The average elevation of the country is about 1,200 feet above sea level, but the surface is wilder and more cut up by rock and jungle than in Chota Nagpore Proper, and there are no level areas of any extent except the valleys of the north Koel and Amanat, to which rice cultivation is confined.

Hazaribagh District.

4. On the north and north-east of Lohardugga, the central plateau of Hazaribagh rises to an average height of 2,000 feet above the sea. This plateau, which is connected by a narrow neck of land with the corresponding level in Lohardugga, occupies only a limited area, while the rest of the district lies at an average elevation of 1,200 or 1,300 feet above sea level. The northern portion of Hazaribagh is divided by a well marked range of hills from the plains of Gaya District, which are about 800 feet below the lower level of Hazaribagh.

Manbhoom District.

5. Due east of Lohardugga, and south-east of Hazaribagh, the district of Manbhoom forms the last step in the gradual descent from the highland of Central India to the delta of Bengal. Here the undulations of the surface become less pronounced, and follow each other at longer intervals than in Lohardugga and Hazaribagh, while level tracts of considerable extent are of more frequent occurrence. In the northern and eastern portions of the district the country is open, and consists of rolling downs dotted here and there with isolated conical hills.

Singbhoom District.

6. The south-eastern corner of the Division is occupied by the district of Singbhoom, an elevated basin shut in on the north, west, and south, by the spurs of the Chota Nagpore plateau and the hills of the Orissa Tributary States, and open on the east towards the district of Midnapore.

Geological character.

Coal.

7. The prevailing geological formations of the Chota Nagpore Division belong to the metamorphic or granite and gneiss series, and to the sub-metamorphic or slate and quartzite series. Coal-bearing shales and sandstones occur over the whole area frequently in conjunction with iron stone, shales and hæmatite. Limestones are rarely met with, and in most places where they occur, it is believed that the supply would not suffice for large iron works for a lengthened period. The known coal-

fields of the Division and some of their more important characteristics are shown in the following table :—

No.	Name of coal-fields.	Where situated.	Area in square miles of coal-bearing strata.	Thickness of coal-bearing strata.	Estimated yield in tons.	Percentage of carbon, ash and volatile matter.	Maximum thickness of seams.	REMARKS.
			sq. m.	ft.				
1 2	Lakharpur Bisrampur	Sirgoojah State.	400	4,500	...	... ...	...	
3	Jhilmilli .	Sirgoojah .	35	...	...	... ...	...	
4	Hingir or Raigarh.	Gangpur Tributary State.	1,000	...	...	... ...	...	
5	Aurunga .	Lohardugga District.	97	1,500	20,000,000	Carbon 36·5 (*a*) Ash 27·5 Volatiles 29·3	...	(*a*) Specimen taken from old surface coal: better results expected from lower seams.
6	Hutar .	Lohardugga .	78	2,750	...	Carbon 55·35 Ash 10·7 Volatiles 28·	...	
7	Daltonganj .	Ditto .	200	...	11,600,000	Carbon 64·4 Ash 13·4 Volatiles 22·4	...	
8	North Karanpura.	Hazaribagh .	472	2,000	8,750,000,000	Carbon 64·5 (*b*) Ash 8·5 Volatiles 27·	77 ft. avg. 30 to 40 ft.	(*b*) Specimens analysed were taken from the best coal of both fields.
9	South Karanpura.	Ditto .	72	...	75,000,000			
10	Ramgurh .	Ditto .	40	4,000	...	... ...	...	
11	Bokaro .	Ditto .	220	...	1,500,000,000	... ...	...	
12	Itkhuri .	Ditto .	22½	...	2,000,000	Ash 30 p. c.	...	
13	Chope .	Ditto .	¾	...	...	* (*c*)	...	*(*c*) Not regularly tested but reported worthless, except for lime burning.
14	Karharbari (*d*)	Ditto .	11	...	1,360,000,000	Carbon 67·51 Ash 11·67 Volatiles 20·82	...	(*d*) Worked by East Indian Railway.
15	Jharia .	Manbhoom .	200	...	...	... ...	60 ft.	

Iron, &c.

8. Iron of excellent quality is worked on a small scale by the aborigines in all parts of the Division. Specimens of ore from the Karanpura valley in Hazaribagh were found, on analysis, to yield from 35 to 60 per cent. of iron, and the magnetic iron ore found in the metamorphic rocks contained as much as 70 per cent. of metal. Copper is found in Singbhoom, and lead, containing a large proportion of silver, has been met with in Hazaribagh and Manbhoom. Tin and antimony were formerly worked in Hazaribagh. Mica mines, long managed on the wasteful native system, are likely to be opened out by European practical miners in the north of that district. Gold is washed in small quantities from the sands of the rivers Subarnrekha and Sunkh in Lohardugga, and the Ib and Brahmini in the State of Gangpore. Good building stone is found in many places throughout the Division.

Forests.

9. The gradual spread of cultivation, the incessant demand for railway sleepers, and the practice of girdling the trees for resin, have combined to denude the districts of Hazaribagh, Lohardugga and Manbhoom of most of their valuable *sál* forests. Extensive jungles still remain uncleared in these districts, but nearly all the trees big enough to make sleepers have been thinned out, and little besides saplings is left. Forest reserves have been formed by Government in the north-west of Hazaribagh and in the western corner of Singbhoom, and throughout the Division the landholders are now beginning to establish small reserves locally known as *rakhwats*. These, however, are not worked on any regular system ; their boundaries are usually ill defined, and the conflicting claims of the landlord and the villagers are a fruitful source of litigation in the criminal courts. A scheme for preserving the private forests of Chota Nagpore has recently been under consideration by Government. A forest officer was deputed to examine the forests, but it is believed that, except in Singbhoom, which has only been resorted to for sleepers within the last two or three years, the private forests of the Division contain no timber worth preserving. In the Tributary States, the original forests are still virtually untouched. Cart roads do not exist, and the rivers cannot be used for floating timber. Here the proposed railway will open out an enormous area of virgin forest which, if properly worked, ought to meet almost any demand for an indefinite period.

Agriculture : rice cultivation.

10. The system of agriculture followed in Chota Nagpore is determined, particularly in the case of rice, by the physical conformation of the country. This consists mostly of long undulating ridges, between which the drainage runs off to join the large streams. The lower slopes of these ridges and the swampy ground between, supply the only land on which a wet rice crop can be raised. The soil is, in the first instance, brought under cultivation by cutting level terraces out of the hill side, a small bank to hold up water being left round the edge of each plot. The hill sides, thus treated, present the appearance of a series of steps, varying

from one to five feet in height; and when the slopes are too steep for terracing or the soil too stony for cultivation, the bed of the stream is banked up and made into one long narrow rice field.

Oilseeds and other upland crops.

11. Wheat, barley, various kinds of millet, Indian-corn, *marua*, pulses, oilseeds, sugar-cane, betel-nut, cotton, tobacco are cultivated on the higher levels of the surface where the rice terraces leave off. In Hazaribagh and Chota Nagpore Proper, tea is grown by European planters on lands of this class. In 1880-81 thirty-six tea plantations had been opened in the two districts. The gross yield for that year is reported as 237,666 pounds.

Tea.

Area and population.

12. The area and population of the Chota Nagpore Division, as ascertained in the census of 1881, are as follows:—

	Area in Sq. miles.	Population.
Lohardugga	12,044	1,607,038
Hazaribagh	7,021	1,072,486
Manbhoom	4,914	1,042,117
Singhoom	4,503	551,348
Tributary States	15,419	441,302
	43,901	4,714,291

These figures represent the results of the preliminary totalling of the detailed returns and consequently are liable to some correction; but they are accurate enough for practical purposes. The details of the census of 1881 have not yet been published, but it may be noted that, of the population recorded in the previous census of 1872, 54 per cent. belonged to aboriginal or semi-aboriginal races. Taking the Division as a whole, we may fairly assume that at least 50 per cent. of the population are more or less of aboriginal descent. No difficulty, therefore, need be anticipated in procuring cheap labour for the earthwork of the new railway, even in the most unhealthy parts of the line. The aborigines of Chota Nagpore are conspicuous for their immunity from malarious fever, and it is mainly by labourers of this class imported into Assam that new tea gardens are opened out in that unhealthy province.

Trade routes.

13. It will be clear from paras. 2 to 6 above, and from the annexed map, on which some of the chief lines of hills have been roughly delineated, that on the west and south Chota Nagpore is shut in by the hills of the Central Provinces and Orissa, while there are but few practicable outlets through the bordering ranges which mark the descent into the plains of Behar. Hence the main currents of export trade, like the main lines of drainage, follow the natural slope of the country from west and north-west towards the east, converging gradually after entering Manbhoom District, on the great trade centre of Raneegunge in Burdwan. Three main exceptions to this general rule deserve special notice:—

(i) Of the surplus produce of Palamow and Sirgoojah, which is collected in the marts of Garwa, Daltongunge, and Maharajgunge in Palamow, a certain portion is exported to Gaya, Shahabad and Mirzapore, and it may be expected that the Gaya-Patna State Railway will attract a continually increasing proportion of the trade of these marts, as well as of Chuttra in the west of Hazaribagh.

(ii) Part of the trade of the north of Hazaribagh, collected in the mart of Mirzagunge, finds its way into Monghyr District, and part is exported from Giridih on a branch of the East Indian Railway.

(iii) The export trade of that part of Dhulbhoom, the eastern pergunnah of Singbhoom, which lies to the east of the Kâpargâdi hills, has its natural outlet towards Midnapore. Ghatsila, the chief village of Dhulbhoom, is not much more than 60 miles from the mouth of the Midnapore Canal, and we may expect that when the roads in Singbhoom are put in order, a very considerable traffic will pass out of the district by this route.

Export routes.

14. The areas of country which either now export, or may ultimately be expected to export, by way of Gaya, Giridih and Midnapore, have been roughly marked on the map in blue. At present a certain proportion of the trade, even of these remote parts, flows towards Raneegunge, but it can hardly be expected that this reversal of natural conditions will continue when communications come to be improved. All the exports from the remaining areas find their way sooner or later through Manbhoom District to Raneegunge or Bankura, on one or other of the roads marked with green arrows on the map. I shall attempt to show in detail for each district how this takes place. In Hazaribagh the surplus for export is collected at Chuttra, Tandawa, Mirzagunge, Gola and Hazaribagh, all of which are shown on the map. The exports of Tandawa, Chuttra and Hazaribagh pass for the most part down the Grand Trunk Road by cart to Burrakur or Raneegunge direct; Mirzagunge exports by Giridih on the East Indian

Railway, and Gola through Manbhoom to Raneegunge or Bankura. The produce of Lohardugga, excluding that of the area marked blue which exports to Mirzapore or Behar, and that of an undefined area in the west of the district which deals with Chuttra, is concentrated at Ranchi or Jhalda in Manbhoom, and dispatched to Raneegunge or Burrakur through Purulia. The exports of Singbhoom, excluding Dhulbhoom, are sent by Chaibasa to Purulia, and thence to Bankura or Raneegunge.

Import routes.

15. The import trade follows the same main lines as the export trade, and needs no special description. Places which export to Raneegunge procure their exports from there, and the same holds good in the case of the areas exporting by Gaya or Mirzapore, Giridih and Midnapore.

Attraction of Raneegunge.

16. It was remarked above that the bulk of the exports of Chuttra and Hazaribagh are sent by cart along the Grand Trunk Road to Burrakur or Raneegunge. In the former case they pass within 26 miles of the Giridih Railway Station, and in the latter also within a mile of the station at Burrakur. This preference for Raneegunge over the two nearest stations on the line is mainly due to the fact that the trade of Raneegunge is incomparably larger than that of either Burrakur or Giridih, and that consignors can count upon disposing of their entire produce to a single wholesale dealer and getting at once whatever they may require for the return journey. At Burrakur or Giridih, where the machinery of trade is as yet imperfectly developed, a consignor of country produce would probably have to dispose of his stock in driblets, and to pick up his return load of piece-goods, salt and tobacco from half a dozen different dealers. For this reason, and probably also because the consignors have running accounts with the large merchants at Raneegunge, the majority of carts exporting country produce travel for their market 70 miles beyond Giridih, their nearest railway station, and 25 miles beyond Burrakur. The point is chiefly of importance as illustrating the indifference to delay, and the reluctance to abandon traditional routes and methods which are so characteristic of the ordinary country trader. If, in cases like this, the common economical maxim, that trade will seek out and follow the shortest and cheapest routes, could be implicitly relied on, it ought to follow that when the railway is open, Purulia will at once take the place of Raneegunge as the distributing centre for the trade of a large portion of Chota Nagpore. This, however, will hardly be the case unless the native firms at Raneegunge open branches at Purulia, or unless some influential dealers migrate from the large mart of Jhalda in the west of Manbhoom.

Conservatism of native trade.

Minor trade agencies.

17. It is not pretended that the foregoing paragraphs give anything more than a very general outline of the operations of trade over a large province. No reference has been made to the weekly markets held in all large villages, to the small travelling dealers (*bepāris*), or to the agents of large merchants who settle for a time at convenient centres and buy up the produce of the neighbourhood. In a country where but few large centres of trade exist, it is from sources such as these that the chief marts shown in the map derive their stocks for export, and the imports are distributed through the same channels. No statistical record of these operations is possible. As Chota Nagpore is gradually opened up by the railway and by improved roads, we may expect that the new marts will spring up, and that the trade of the Division will tend to concentrate itself, while itinerant dealers, and transport by means of pack bullocks will tend to disappear.

Exports.

18. The chief exports of the Chota Nagpore Division are the following :—

Rice—
  Indian-corn—chiefly from Manbhoom.
  Wheat—from Hazaribagh.
Pulses.—Mung (Phaseolus Mungo).
  Urid (Phaseolus Roxburghii) known as Biri in Manbhoom.
  Gram (Cicer arietinum), not grown in Lohardugga.
Oil seeds.—Sarsua—Mustard.
  Til (Sesamum orientale).
  Tisi—Linseed.
  Surgujia (Guizotia oleifera).
Cotton—only from Palamow.
Timber—from South Lohardugga and North Singbhoom.
Bamboos—
Chope—or rope made of jungle fibre.
Bábui—string made of bábui grass.
Tusser Silk—Manbhoom and Hazaribagh.
Tusser Cocoons—
Hides—
Shellac—from Ranchi and Manbhoom.
Ghee—Hazaribagh and Palamow.
Tea—Hazaribagh and Lohardugga.
Jungle products—Petals of the *mohua* tree.
  Catechu.
  Resin.
  Sticklac.
  Dye substances of various kinds.
  Wax.
  Gallnuts (*haritáaki.*)
Coal
Iron } from Hazaribagh and Lohardugga.
Mica

Imports.

19. The chief imports are—

European piece-goods.
" twist.
Blankets.
Salt.
Spices.
Molasses.
Tobacco.
Umbrellas.
Brass utensils.
Paper.
Wines and spirits.
Oilman's stores.
Gunny bags—to Hazaribagh.

Trade of Tributary States.

20. I will now attempt to summarize, as concisely as possible, the available information regarding the trade of each district of the Division. Nothing certain is known about the trade of the Tributary States, except that there are no marts worth mentioning; that the resources of the country are quite undeveloped, and that the export and import trade is carried on pack-bullocks, and is in the hands of itinerant traders who barter salt and piece-goods for local produce.

Trade of Lohardugga.

21. The principal seats of trade in Lohardugga District are Ranchi, Lohardugga, Palkot, Barwa, Tamar, Bundu, Garwa, Daltongunge and Maharajgunge. Garwa, in Palamow, forms the distributing trade centre for the surplus produce of great part of Sirgoojah, of the Tributary States further west, and of Palamow Sub-Division itself. The Garwa market is held during the dry season on the sands of a river, and is one of the largest in the Chota Nagpore Division. Sticklac, resin, catechu, cocoons of tusser silk, hides, oilseeds, ghee, cotton and iron are there collected for exportation. Rice and other food-grains, brass vessels and piece-goods, blankets, silk, salt, tobacco, spices, drugs, and beads are brought to market for local consumption, and to supply the stocks of itinerant merchants, who take these articles into Sirgoojah and Korea. All over Lohardugga District trade is carried on by periodical markets, held once or twice a week, according to the importance of the neighbourhood which they supply. But by far the largest amount of business, at any rate in Palamow, is transacted in what may be called the "door-to-door trade," by travelling merchants who buy up produce from the cultivators. Owing to the general insolvency of the producing classes of Lohardugga, this trade is to a great extent carried on by advances, and the prices paid are consequently very low. A large and increasing amount of country produce is exported from Lohardugga. Rice goes to Behar through Chuttra and Gya: oilseeds to Calcutta through Jhalda in Manbhoom. Hides are bought up at Ranchi by wholesale dealers, who employ paid agents in the interior to work in connexion with the village chamars. The value of the export of hides in 1879-80 was estimated at Rs. 35,000. In the same year the gross produce of tusser cocoons was estimated at Rs. 31,50,000 sold for export at from 4 annas to 8 annas per 100 cocoons. Of these, 150,000 were produced in Palamow and exported to Gaya, Shahabad and Mirzapore: the remainder being sent through Jhalda and Eloo in Manbhoom to Lower Bengal. A considerable amount of ghee is exported from Palamow, where cattle are driven in for pasturage from Shahabad, Mirzapore and Gaya. In the following year (1880-81) the crop of sticklac was very large and the demand unusually brisk. The prices per maund fluctuated remarkably during recent years, thus :—

Years.	R		R
1875-76	50	@	20
1877-78	30	,,	16
1879-80	21	,,	14
1880-81	0	,,	18

The imports of piece-goods into Lohardugga for local consumption and for re-export to the Tributary States are said to be increasing rapidly; but as they enter or leave the district at numberless points, no accurate account of the quantity can be kept. It is extremely difficult to register trade carried on pack bullocks. The following table, taken from the Administration Report of the Chota Nagpore Division for 1879-80, shows the approximate proportions of the several descriptions of piece-goods imported, their value, and the price at which they are sold :—

	Approximate proportion of import from Calcutta.	Approximate value imported.	Selling price per piece.				
		R	R	a.		R	a.
Grey jacconets	4	20,000	3	14	to	6	0
„ shirtings	40	2,00,000	3	14	„	8	0
„ madapollams	3	15,000	1	8	„	2	12
„ dhooties	28	1,40,000	0	12	„	1	6
White jacconets	1	5,000	3	14	„	8	0
„ mulls	4	20,000	2	0	„	8	0
Coloured, printed or dyed cambrics	1	5,000	1	4	„	4	0
Prints and chintz	6	30,000	9	0	„	12	0
Other sorts each less than 3 per cent. of whole imports	13	65,000					
	100	5,00,000					

About 100,000 maunds of salt are supposed to be consumed annually in Lohardugga District. Most of it is Liverpool salt imported from Calcutta by way of Raneegunge, Purulia, Chuttra, and Gaya; but in the south of the district the people use "Kurkutch" salt brought from Ganjam and Sumbulpore on pack bullocks. Taking the average annual consumption per head at 12 lb., the figure adopted by Sir John Strachey at page 230 of the Finances and Public Works of India, it would appear that the district ought to consume no less than 241,055 maunds of salt, or more than twice the amount of the official estimate.

As affecting the Railway.

22. No sort of guess at the quantity or value of the Lohardugga trade can be arrived at from the information put together in the last paragraph. I need only remark that whatever proportion of this trade comes on to the proposed Railway will at first be carried only 45 miles from Seetarampore to Purulia or *vice versâ*. As time goes on, and feeder roads are opened out, we may expect that the traffic of the south and south-east of the district will strike the line somewhere in the Subarnrekha Valley.

Trade of Hazaribagh.

23. Chuttra, about 36 miles north-west of the civil station, is the chief market of the Hazaribagh District. Situated on a comparatively level tract between the central plateau of the district and the tangled mass of rock and ravine which forms its western frontier, in such a way as to command the openings of the passes from the north-west, west and south-west, it is well suited by its position to be the distributing market for the country produce of Palamow and the Tributary States. The principal articles imported into Chuttra are the following:—Rice, Indian-corn, oilseeds, pulses and mohua petals are imported from Lohardugga and the Tributary States of Gangpore, Jushpore and Sirgoojah. From the same places are also brought sticklac, resin, tusser silk cocoons, gum, cotton and unwrought iron. The districts of Gaya and Shahabad send wheat, gram, *masur* (Ervum lens), *khesari* (lathyrus sativus) and similar cereals, as well as turmeric, pepper, and other vegetables. Zinc and tin are also sent in small quantities from these districts. Tobacco, is imported from Patna. English cloth, brass or bell metal, household utensils, salt, pepper and *supari* or betel-nut are imported from Burdwan, Raneegunge and Calcutta. The export trade supplies Lohardugga and the Tributary States with English cloth, salt, pepper, tobacco, household utensils, turmeric, &c. Rice, Indian-corn, *marua* (eleusine coracana), pulses, oilseeds, mohua flowers and ghee are sent to Gaya and Shahabad. Oilseeds and ghee are also exported to Burdwan and Raneegunge. Patna takes iron and certain proportion of sticklac; but the bulk of the lac which finds its way into the Chuttra market is sent to the great lac factories of Mirzapore District.

Exports.

24. The exports from Hazaribagh District in 1879-80 and 1880-81 are estimated as follows:—

Articles.	1879-80. Quantity.	Value.	1880-81. Quantity.	Value.
	Mds.	R	Mds.	
Tusser cocoons (*a*)	...	30,000 to 35,000	...	
Tusser silk	200	...	200	
Catechu	1,100 to 1,200	...	...	
Rice	50,000	...	35,000 to 40,000	
Grain and pulses	20,000	...	10,000 „ 12,000	
Oilseeds	100,000	...	15,000 „ 20,000	
Ghee	...	...	30,000 „ 40,000	

(*a*) Partly produced in Hazaribagh, partly imported from Singbhoom (*sic*); exported to Mobarakpore in the North-Western Provinces.

(*b*) Exported to Calcutta.

Besides these, says the report from which the foregoing figures are taken, iron, timber, bamboos, *chope*, &c., are exported to Patna, and coal, timber, tea, hides, &c., to Calcutta; but as these articles do not pass through the local marts, no attempt was made to collect statistics regarding them.

Imports.

26. The imports from Hazaribagh during the same year are thus estimated.

European piece-goods.

	1879-80. Value.		1880-81. Value.
	R		R
To Hazaribagh	73,438	=1,89,430	1,29,828
Giridih	14,292		
Chuttra	1,01,700		

The decrease in 1880-81 is attributed to a decline in the number of marriages; but this cause itself is left unexplained. All the piece-goods received in Hazaribagh and Giridih are required for local use, but of the Chuttra imports nearly one-fourth is exported to Lohardugga and Palamow. The different descriptions of piece-goods and the proportion each bear to the entire quantity imported are shown as follows :—

1. Grey jacconets	1	5
2. „ shirtings	42	6
3. Madapollams	24	0
4. Dhooties	2	2
5. White jacconets	7	0
6. „ mulls	3	5
7. „ shirtings	6	0
8. Colored, printed or dyed cambrics	0	6
9. Prints or chintz	1	2
10. Colored garments	2	7
11. All other sorts	8	7
TOTAL	100	0

The imports of salt in 1879-80 and 1880-81 are given as follows, only the estimated value being shown for the latter year :—

	1879-80. Quantity. Mds.	1880-81. Value. R
Hazaribagh	8,000	34,000
Giridih	30,000	35,000
Chuttra	75,000	1,94,750
TOTAL	1,13,000	4,68,650

Here, again, more than half of the import to Chuttra is re-exported to Ranchi, Lohardugga and Palamow. In 1879-80 it was estimated that from 55,000 to 60,000 gunny bags were imported into Chuttra, and from 15,000 to 20,000 into Giridih. Doubtless there is a steady demand for gunny bags for use in the export trade both by carts and pack bullocks, but no reliance can be placed on any estimate of the quantities.

Trade of Singbhoom.

27. The exports and imports of Singbhoom are much the same as those of other districts in Chota Nagpore. Rice and oilseeds are exported by petty itinerant traders, who move about from village to village during the cold weather purchasing country produce, or taking it in exchange for salt which they import, mostly on pack bullocks, from Midnapore. Tusser cocoons and hides are collected on a system of advances by agents from Bankura and Midnapore, the latter being exported by carts. The following table shows the estimated exports for 1879-80 :—

	Mds.	Value. R
Rice	18,400	26,450
Tusser cocoons	17,591 kahans	1,08,294
Hides	47,500 pieces	65,312
Horns	1,040 mds.	12,505
Til	3,000	6,375
Surgujia	2,200	3,300
Sarsua	1,771	4,095
Lac	919	18,954
Haritaki (gallnuts)	4,200	3,150
TOTAL VALUE OF EXPORT		2,48,435

The imports are returned as follows :—

	Mds.	Value. R
Salt	29,511	1,56,777
Tobacco	4,940	90,772
Betel-nut	2,030	25,628
Cotton thread	4,595	1,97,585
Turmeric	700	5,600
Pepper	100	2,000
		4,78,362

European piece-goods.	Approximate quantity imported.	Price per piece, etc., in Singbhoom.	Approximate value of goods.
		R a. R a.	R
Grey jacconets	757 pieces of 20 yards	3 0 to 3 8	2,413
„ shirtings	25,571 „ 38 „	1 14 „ 6 8	1,02,284
„ madapollams	433 „ 38 „	2 0 „ 15 0	2,598
„ dhooties	6,870 pairs of 5 „	1 8 „ 2 4	11,998
White jacconets	525 pieces 20 „	3 8 „ 6 8	2,888
„ mulls	1,394 „ 20 „	2 8 „ 3 8	4,443
Colored, printed or dyed cambrics	20 „ 20 „	10 0 „ 0 0	200
Prints and chintz	402 „ 10 „	5 0 „ 9 0	2,487
Grey T cloth sheetings	85 „ 24 „	4 0 „ 9 0	488
Jeans, drills	34 „ 40 „	6 0 „ 8 0	317
Mulls	220 „ 20 „	3 0 „ 5 0	797
Scarves and chudders	1,968 pieces or pairs	1 2 „ 2 0	2,952
Cambrics	40 pieces of 12 yards	5 0 „ 6 8	240
White shirtings	164 „ 40 „	8 0 „ 10 0	1,476
Tanjibs	10 „ 20 „	5 0 per piece 0 0	20
Lappets and lenos	195 „ 10 „	2 4 „ 3 8	561
Checks, spots or stripes	60 „ 20 „	5 8 „ 7 8	42,268
Velvets	13 „ 40 „	13 0 „ 20 0	260
Dhooties and sarries	1,636 „ 5 „	2 0 „ 4 0	6,544
Country piece-goods		Total value	2,20,988
Saloom cloth	619 pieces of 20 yards	2 8 per piece 3 8	1,934
Dhooties	6,050 „ 5 „	2 0 „ 3 0	15,150
Chudders	6,075 pairs 3 „	1 4 „ 3 0	8,353
Sarries	10,000 „ 6 „	2 0 „ 3 8	25,000
		Total value	50,437
Total estimated value of exports	... ...	......	2,48,435
„ „ „ imports	... ...	......	7,49,787

Trade of Manbhoom.

28. I have already pointed out, in paras. 14 to 16 above, the important position occupied by Manbhoom in relation to the trade of the Chota Nagpore Division. In this district considerable attention has been paid to the question of trade statistics, and for the last three years special reports on the subject have been drawn up by a native officer of great local experience, from whose estimates the following tables have been compiled. The figures, however, are admittedly conjectural, and must be taken as approximate only. The table of imports includes articles afterwards exported to other districts, while the table of exports purports to deal only with exports from Manbhoom itself :—

Exports.

Estimated exports of Manbhoom District for the year 1879-80 to 1881-82.

ARTICLES.	1879-80.		1880-81.		1881-82.		REMARKS.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Mds.	R	Mds.	R	Mds.	R	
Sticklac	10,000	2,40,000	1,60,000	31,00,000	92,000	17,74,000	
Shellac	Not ascertained.		34,000	16,63,875	16,000	6,91,000	
Rice	20,000	30,000	15,000	18,750	...	...	Not exported in 1881-82.
Indian-corn	40,000	50,000	26,000	26,000	...	...	
Pulses	30,000	75,000	8,000	18,000	...	...	
Oilseeds	20,000	77,000	10,000	33,750	10,000	32,500	
Hides	...	50,000	...	20,000	50,990*	70,000	* Pieces.
Timber	...	42,000	...	32,500	...	40,000	
Bábui string	10,000	15,000	20,000	35,000	40,000	60,000	
Tusser cocoons	30,000†	1,50,000	15,000†	1,10,625	7,500†	49,375	† Kahans.
Tusser silk	...	...	...	...	15,000	75,000	
Gallnuts	...	...	...	...	30,000	30,000	
Tamarind	...	...	...	...	40,000	20,000	
Stone plates	...	...	...	10,000	...	50,000	
Horns	...	...	...	...	1,000	14,000	
TOTAL VALUE	...	7,29,500	...	50,68,500	...	29,05,875	

Sticklac.

29. Sticklac is exported to Burdwan, Bankura, Beerbhoom, Calcutta and to Mirzapore in the North-Western Provinces. It is collected by paid agents of the manufacturers, who come to the trade centres of

Shellac.

Manbhoom during the gathering seasons, and make advances to petty brokers dealing direct with the cultivators. Shellac is manufactured at Jhalda, Eloo, Ragunathpur and Chas, and exported to Calcutta. In 1879-80 twenty-six lac factories were at work in the district, but most of them are small concerns, and in 1881-82 only one of them worked throughout the year.

Rice.

Oilseeds.

30. Very little is known about the export of rice. On the one hand, the short exports of 1879-80 and 1880-81, and the stoppage of exportation in 1881-82 shown in the estimate, are attributed to the reduced demand consequent on good harvests in Bengal Proper, and the local surplus is supposed to be stored, awaiting a rise of prices. On the other hand, the district officer doubts the existence of any considerable surplus, and thinks that a good deal of the rice exported from Manbhoom comes from Singbhoom. My own enquiries in the Govindpur Sub-Division, to which I shall refer in detail below, lead me to think that the latter view is correct. In 1879-80 Indian-corn was exported to Patna and Monghyr. *Vrid* locally known as *biri* is the only pulse exported. It goes to Ghatal in Midnapore by way of Bankura and Burdwan. The export of oilseeds appears to be under-estimated. From February to July 1881, about 4,000 maunds of oilseeds were exported from the western part of the Govindpur Sub-Division, and the surplus of the whole district is probably at least 10 or 12 times as much.

Hides.

31. Hides are exported to Calcutta from the south of Manbhoom through Bankura by merchants residing at the latter place, who have agents at Purulia, Jaipur, Jhalda, Raghunathpur and Manbagar. From Govindpur they are exported through Burrakur.

Timber.

32. The export of timber for the last three years is estimated as follows :—

	1879-80.	Rate.	1880-81.	1881-82.	Rate for last two years.
Large sâl beams .	1,000	1-0 to 1-8 p. c. ft.	700 or 800	1,000	1-6 per c. ft.
Sâl sleepers . .	10,000	3-0 to 3-8 each.	5,000	10,000	3-8 to 4-0 each.

There is also a considerable export of *rollahs* (sâl saplings) to Burdwan and Bankura, where they are used for house posts, rafters, &c. The district officer remarks that "the large demand for these young trees probably causes much more harm to the forests than that for heavy timber, which can only be cut from mature trees."

33. The trade in *bâbui* string made from jungle grass is on the increase. Large quantities pass through Purulia from Singbhoom, and the article is in great demand in Bankura and Burdwan for use in thatching.

Tusser silk cocoons.

34. Tusser cocoons are exported to Bankura, Burdwan, Beerbhoom and Azimgurh in the North-Western Provinces. No reliance can be placed on the figures entered in the table under this head. There is no reason for believing that the exports have declined in the last three years so remarkably as the estimate would show. It may be hoped that the cultivation of tusser silk will some day be developed under European supervision, and the improved processes of reeling described by W. Wardle introduced.

Potstone plates.

35. The trade in potstone plates is said to have increased greatly of late years. Its chief centre is Patkum in the south-west corner of the district. The opening of the railway will probably stimulate the demand for these heavy articles. The supply of the stone is said to be unlimited. The following remarks on the subject are extracted from a paper on Manbhoom District by Mr. V. Ball :—" Chloritic schists, passing on the one hand into Talcox, and on the other into serpentinous rocks, occur not uncommonly in the sub-metamorphic and somewhat less frequently in the metamorphic series. In building, the varieties of this material have only been used on a small scale for ornamental purposes, for which some of them, as being tough and at the same time easily carved, are particularly suited. They are more extensively employed in the manufacture of altars, idols, plates and bowls. In the southern part of Manbhoom on the frontiers of Singbhoom there are numerous workings, which generally take the form of narrow mines, but are deserted during the rains. From these mines a considerable quantity of stone is annually extracted ; the blocks are roughly dressed to the shape required, be it for *lingam* plate or bowl. They are then fixed in a rude lathe, cut into form, and finished with a smooth surface. When finished, they are carted off to Burdwan, where they are in great demand, and a portion are sent on to Calcutta for sale. One class of the varieties used stands fire well, while the other does not. The former is, of course, the most esteemed by the natives. The cracking of the latter is probably due to the water in combination in the more chloritic varieties which becomes released on the application of heat. In many of the ancient temples in Chota Nagpore, images made from this material are met with."

Estimated imports of Manbhoom District for the years 1879-80 to 1881-82.

Articles.	1879-80.		1880-81.		1881-82.		REMARKS.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Mds.	R	Mds.	R	Mds.	R	
European piece-goods	...	3,96,000	...	4,95,000	...	8,67,832 (*a*)	(*a*) Of this deduct R 1,20,000 as value of goods re-exported to Lohardugga and Singbhoom. (*b*) Out of this, 56,000 mds. sent to other districts. (*c*) 937 mds. valued at R 30,000 exported to other districts.
Country piece-goods	...	98,500	...	1,23,125	...	2,49,297	
Salt	1,45,000	6,43,434	1,81,250	8,04,288	1,70,000 (*b*)	7,65,000	
Twist	6,600	1,98,000	9,900	2,97,000	11,311 (*c*)	3,62,000	
Spices	...	55,000	...	68,750	...	1,10,000	
Tobacco	...	...	15,000	67,500	21,333	96,000	
Brass utensils	...	...	...	1,00,000	...	70,000	
Gram	...	...	8,000	17,000	8,000	16,000	
Cocoanut oil	...	...	218	4,375	250	4,000	
Paper	...	...	...	8,150	...	10,000	
Umbrellas	...	10,500	...	13,125	...	14,000	
Sugar	...	...	562	7,312	950	12,350	
Imported liquor	...	3,000	...	2,250	...	395	
TOTAL VALUE	...	14,04,834	...	20,08,375	...	25,76,874	

European piece-goods.

36. European piece-goods are imported from Bankura, Raneegunge and Burrakur. The principal centres of distribution are Purulia, Jhalda, Raghunathpore, Govindpur and Chas. The following statement shows the value of the amount estimated to have been imported into each centre during the last three years :—

	1879-80.	1880-81.	1881-82.
	R	R	R
Purulia	2,26,000	2,82,500	3,75,000
Raghunathpore	65,000	81,375	1,55,000
Jhalda	62,000	77,500	1,55,000
Govindpur	27,000	33,750	1,30,000
Chas	16,000	20,375	52,832
TOTAL	3,96,000	49,55,000	8,67,832

Salt.

The consumption of European piece-goods has increased of late among the aboriginal and semi-aboriginal races of Manbhoom, who are also believed to have taken a large proportion of the umbrellas imported in the last three years. Salt is imported by way of Raneegunge and Burrakur, and distributed through the same centres as piece-goods. Brass utensils are imported from Bankura, and the import is likely to continue, as the Manbhoom braziers do not make enough for local wants, and their workmanship is clumsy.

Manbhoom figures how compiled.

37. Clearly the Manbhoom statistics have been compiled with great labour, and aim at a higher standard of completeness than those supplied from other districts of the division. They are based almost entirely on the following data :—

(*a*) Statements of local traders resident in Purulia as to the quantity or value of the stocks passing through their hands during the year; and the proportion of such stocks drawn from, or exported to, districts other than Manbhoom. Traders from the interior of the district were questioned on these points when they visited Purulia; and in all cases, from 30 to 50 per cent. was added by way of correcting the Mahajan's natural tendency to understate his stocks.

(*b*) Estimates made by local traders at the instance of the compiling officer of the quantity or value of particular articles exported from, or imported into, the whole district.

(*c*) Estimates framed by the compiling officer of the quantity or value of particular articles which the population of the district ought, on an average, to consume.

(*d*) In some few instances the traders' books were referred to.

Statements of Mahajans untrustworthy.

38. With regard to (*a*) it would be waste of time to dwell upon the various sources of error which such a method of enquiry involves. Every local trader is possessed with a constant dread of enhanced license-tax, and regards statistical enquiries of any kind with the more suspicion because he is quite incapable of understanding the remote general objects which such enquiries have in view. He may believe that the officer with whom he is talking at the moment has no ulterior designs in respect of taxation; but nothing would persuade him that incautious disclosures made by him as to the extent of his dealings, might not hereafter be used by another officer, or another department, for the purpose of assessing a new tax or enhancing an old one. The clumsy expedient of adding a uniform percentage to the statements of stock could only yield correct results if every man lied in exactly the same ratio to the truth. In the present case, as the Mahajans were informed that this correction would be applied, there can be little doubt that many of them made allowance for it in framing their statements. As to (*b*), no one who has seen anything of the Mahajan class in Chota Nagpore can have failed to be struck by their peculiar inability to take a general view of any subject. Each man knows his own business and nothing more, and it is simply preposterous to expect him to be able to estimate the exports or imports of a whole district, which to him represents merely a set of arbitrary boundaries laid down for the convenience of the courts. Least of all would he be able to distinguish local exports and imports from goods in direct or indirect transit to other districts. At the best, moreover, the enquiry was only partial. It is not pretended that all the traders in the district were consulted, and that the figures represent the total of their statements and estimates. On the contrary, the compiling officer admits that he never left Purulia, and that he merely took any opportunity that offered of questioning traders from the interior who happened to come to Purulia.

Estimates from population not generally applicable.

39. To argue from the recorded population of a district to its probable ultimate consumption is no doubt a legitimate process, but it can only be applied with confidence in the case of salt, and perhaps of some staple food-grains. Thus, in the case of salt, we can say that 17 lbs. is the amount required during the year by an adult, and that 12 lbs. is the average consumption in India, and we may infer from this, that with improved communications and a low duty, the Chota Nagpore Division may be expected to consume perhaps 600,000 maunds of salt. An attempt has been made by the compiler of the Manbhoom figures to calculate the import of European piece-goods on a somewhat similar method. Taking the population of the district at 1,042,117 as recorded in the last census, and deducting 281,174 for children and persons who do not wear European cloth, the remaining 760,943 persons are divided into four classes, spending respectively R75, 4, 1, and 0-8 per head on European cloth during the year. The number of persons in each class is then estimated, and their consumption calculated on the following scale :—

		R		R
2,000	of the upper class spending per annum	75-0	=	1,50,000
200,000	of the middle class	4-0	=	8,00,000
200,000	of the cultivators	1-0	=	2,00,000
358,943	of the poorer classes	0-8	=	1,79,471
760,943	persons spend per annum			13,29,471

Deducting from this R3,62,000, being the value of twist imported from Calcutta to be made into cloth in the district, the remainder R9,67,471 is taken as "the minimum value" of piece-goods imported from Calcutta for the "consumption of the people of Manbhoom." It is not clear why a smaller amount was entered in the figured estimate for 1881-82, and subjected to a further deduction on account of re-exports; but the whole calculation rests upon such highly conjectural data, that it would be waste of time to examine it in detail. Again, the import of salt is calculated on the assumption that 999,452 men consume 1 tola a day or 4·56 seers (say 9 pounds) in the year. I have not ascertained why the salt-consuming population was taken at this particular figure, which corresponds neither with the total population of the district nor with the total number of males or heads of families recorded in the last census.

Registered trade on the Grand Trunk Road.

40. Enough has perhaps been said to show that the existing estimates of the trade of Chota Nagpore are based upon methods which could, in no case, be expected to yield correct results, and must be treated as wholly fallacious. I will now reproduce, in a condensed form, the only local statistics which can pretend to even approximate accuracy. In February 1881, arrangements were made for recording daily number of carts passing through the *serai* or rest-house at Govindpur on the Grand Trunk Road, with the starting place and destination of each cart, and the quantity of goods carried. The system was carefully supervised, and the figures are believed to be substantially correct. They certainly do not exaggerate the traffic, as it was to the interest of the farmer of the *serai*, by whom the register was kept, to understate the number of carts on which his own profits depended.

Perhaps 10 per cent. might be added to make up for carts which escaped registration, or were purposely omitted by the farmer, but I have not thought it worth while to apply this correction. In August 1881 the Sub-divisional Officer of Govindpur compiled these statistics for the six months, February to July, and reported on the subject to the district officer, suggesting the introduction of a system by which the traffic of the whole division, except the areas exporting by Gaya, Giridih and Midnapore might be registered at certain points in Manbhoom District. This proposal was recommended to the Commissioner of the Division, but was lost sight of at the time. Shortly afterwards, a new Sub-divisional Officer stopped the registration of traffic at Govindpur. The proposal has since been revived, and a system of registration has been introduced within the last month, which will record a large portion of the trade passing through Manbhoom on the roads marked with green arrows in the map.

Registered exports.

41. Exports from Chota Nagpore to Bengal, registered at Govindpur on the Grand Trunk Road during the six months, February to July 1881.

	Articles.	Quantity in Mds.
Oilseeds	Mustard	22,279
	Surgujia	1,080
	Til	997
	Linseed	756
Oil		1,750
Oilcake		192
Cotton seed		544
Mohua petals		1,923
Timber		7,684
Bamboos		4,288
Sticklac		437
Vrid Biri		389
Gram		32
Tobacco		50
Jira spice		32
Hides		96
	TOTAL	43,229

Registered imports.

The imports during the same period were :—

Articles.	Quantity in Mds.
Salt	34,979
Condiments	608
Piece-goods	515
Ganja	300
Wine, &c.	238
Tobacco	206
Rice	250
TOTAL	37,096

Sources of export.

42. Out of the 43,229 maunds of exports, 33,180 maunds were from Hazaribagh, Lohardugga and Gaya Districts. Chuttra in the north-west of Hazaribagh sent 10,511 maunds of oilseeds and cotton. Only 4,682 maunds of produce, chiefly timber and bamboos, were exported from these districts to Burrakur, the remainder being sent direct to Raneegunge past the two stations of Giridih and Burrakur. A much larger proportion (3,316 out of 10,247 maunds) of the Manbhoom exports as opposed to the through trade, was sent to Burrakur.

Sources of import.

43. Of the imports 1,557 maunds were sent from Burrakur, 768 maunds from Burdwan, and the remainder direct from Raneegunge. Out of the total 37,096 maunds recorded, no less than 32,779 maunds were destined for Hazaribagh and Lohardugga. Chuttra in Hazaribagh took 14,454 maunds, including 13,543 maunds of salt.

Figures incomplete.

44. It is not suggested that these figures supply data for estimating the traffic of the entire division. They only relate to a portion of a single route, and it is believed that they do not fairly represent the magnitude of the trade even on that section. The stream of carts passing along the Grand Trunk Road, which is noticeably large from September to March inclusive, falls off with the beginning of the hot weather in April, while during the rainy months the amount of traffic from distant places is very trifling. The period covered by the statements given above includes, therefore, four months when traffic is slack, and only two (February and March) when it is fairly brisk. Similar figures for an entire year would certainly show a much larger proportional total.

Totals of official estimates worthless.

45. Here I may bring this note to a close. Nothing would be gained by piecing together incomplete and conjectural estimates of the trade of particular districts, and endeavouring to surmise how far

their total falls short of, or exceeds, the entire exports or imports of Chota Nagpore. Nor would facts justify us in assuming that the trade registered at Govindpur represents any definite proportion of the trade of the division. Without some such assumption the Govindpore figures, interesting and curious as they are, can have no direct bearing on the prospects of the new railway. No portion of the trade which they record is likely to be carried by a line running from Sitarampur through Purulia. The causes which at present bring a large share of the trade of Hazaribagh, and of the other areas which send their produce to Chuttra, down the Grand Trunk Road to Raneegunge, will operate with equal force when the railway is open; and, if in course of time, this stream of traffic should change its channel, it will flow to Gaya and Giridih rather than to any centre on the new line of rail. At bresent Giridih, like Burrakur, is little more than an overgrown coal depot, its produce market being four miles off at Pachamba. It is, moreover, cut off from the Trunk Road by the unbridged Burrakur river. Carters from Chuttra halting at Govindpur on their way to Raneegunge have repeatedly assured me, that if the Burrakur were bridged, they would take their goods to Giridih; and I expect that when the recently sanctioned bridge over the Burrakur is completed, there will be a sensible decline in the exports through Govindpur from Chuttra, Burhee and Bagodar.

Summary.

46. For the present this note can only claim to have established the following rather meagre conclusions:—

(i) No materials exist for framing even a probable estimate of the quantity or value of the exports or imports of the Chota Nagpore Division.

(ii) The system of trade registration recently introduced in Manbhoom will furnish a mass of statistics accurate enough for all practical purposes; but the new arrangements have only been working since the 1st of June, and figures for any period less than a year would be misleading.

(iii) The railway through Manbhoom and Singbhoom may count upon carrying the surplus produce of those districts, of a great part of Lohardugga, and of that portion of Hazaribagh which exports, by way of Gola and Chasnanda or Jhalda. It will not carry the exports of Palamow or of Hazaribagh districts generally, and it will also miss so much of the trade of the tributary States and Lohardugga as is collected at Chuttra. If I might hazard a conjecture on a subject so obscure, I should be inclined to suggest that the road from Rabkob in Udaipur, through Jashpur to Lohardugga and thence to Ranchi, might fairly be taken to indicate roughly a line north of which trade will flow towards Garwa, Daltongunge and Chuttra, while on the south it will be attracted by the railway. To the east of Ranchi the railway ought to absorb the whole trade of the country except that of the extreme eastern border of Manbhoom District. I say *ought* to absorb advisedly, because great allowance must be made for the strong attraction of Raneegunge, and for the time required for an important trade centre to establish itself on the new line. Until such a centre springs up, the experience of Burrakur teaches us that a large proportion of the traffic with Bengal will run direct to, or from, Raneegunge, even though it has to cross the new railway to reach its consignees.

Enclosure No. 3 to Railway Resolution No. 799 R.C. of 1887.

No. 1080R.C., dated Fort William, the 16th December 1882.

From—The Secretary to the Government of India, Public Works Dept., Railway,

To—The Secretary to the Government of Bengal, Public Works Department.

I am directed to intimate for the information of His Honour the Lieutenant-Governor that at a Conference recently held at Gaya, for the purpose of discussing the question of the reconnaissances which should be made in connection with the projected line of railway between Benares and Cuttack, and at which—

The Hon'ble T. C. Hope, C.S.I., C.I.E.,
Colonel W. S. Trevor, V. C., R. E., Secy. to the Govt. of India, in the P. W. Dept.,
Mr. G. F. K. Hewitt, Commissioner of Chota Nagpur,
Mr. H. H. Risley, Assistant Commissioner of Manbhum,
Mr H. W. Warden, Assistant Secretary to the Govt. of Bengal, P. W. Dept.,
Mr. W. C. Furnivall, Agent and Chief Engineer, Bengal Central Ry. Co.,

were present, the following conclusions were arrived at:—

I.—That in connection with the projected Sitarampur-Nagpur Railway, Mr. Hewitt has now withdrawn all opposition to the southern route.*

II.—That a through railway from Moghal Serai to Cuttack was unanimously approved of, and considered the best means of opening up Chota Nagpur coupled with a connection between such a line and Gaya.

III.—That a line traversing the Ranchi plateau, and descending by Bandgaon and Chakadarpur, or by Palkhet to Laingarh or other suitable point, to a junction with the Nagpur-Sitarampur Railway, was admitted to be the best, but doubts were expressed whether either ghât would prove practicable.

IV.—That in default of such a line over the top of the plateau, a line skirting its base, through the Damuda Valley to Jhalda (a great mart), and thence to Purulia, preferably, or Chandil, joining the through line from Nagpur to Sitarampur at one of those points, was approved. It would open up the Karanpura and Ramgarh coal-fields.

V.—That a variety of reconnaissances were found to be necessary before the best route could be determined upon with any certainty.

2. In pursuance of the above, arrangements have already been made with the Government of the North-Western Provinces and Oudh for examining a line from Moghal Serai to Gharwa near Daltonganj, *viâ* Naughar and the Upper Son, in hopes of finding a less costly crossing of that river than that at Dehri—*vide* Public Works Department docket No. 1045 R. C. of the 9th December 1882, enclosing copy of those orders for the information of His Honour the Lieutenant-Governor.

3. I am accordingly to request that, with the permission of His Honour the Lieutenant-Governor, every effort may be made to complete this season the following reconnaissances.

A.—A line from Gaya to the neighbourhood of Tori at the foot of the Ranchi plateau to the westward of the direct line by Chuttra, which was examined last year.

B.—A junction between some suitable point on this line and Gharwa, up to which the Government, North-Western Provinces, are examining the line from Moghal Serai.

C.—The best ascent discoverable between the Tori point and the top of the Ranchi plateau.

D.—A continuation thence across the plateau and a descent *viâ* Bandgaon and Chakadarpur to the "southern" route of the Nagpur-Sitarampur line. The Government of India, I am to add, attach considerable importance to the discovery of a suitable descent from the plateau in this quarter. Bandgaon and Chakadarpur should not be considered obligatory points, in the event of a better line being obtainable elsewhere. The ghâts in this direction should be carefully and thoroughly explored.

E.—In the event of failure to obtain such a descent (but not otherwise), a line which has been suggested as possible, from Lohardugga to the west of Palkot and descending to either Suadi or Lainghar, may be examined.

F.—A continuation from the descent by Chakadarpur (or thereabouts) by Chaibassa, to the bank of the Mahanadi opposite Cuttack by the valley of the Baitarni, or otherwise, as the Government of Bengal may deem most advisable.

4. I am also to request that the Government of India may be favoured with any information, derived from canal or other surveys, which the Government of Bengal may possess as to this last route and others to Cuttack, including that from Sambalpur.

Enclosure No. 4 to Railway Resolution No. 799 R.C. of 1887.

BENARES-CUTTACK RAILWAY—GAYA BRANCH.

MR. PARKER's Preliminary Report and Estimate.

This branch line, which is included in the general scheme of the Benares-Cuttack Railway, is projected to afford communication between Gaya and Palamow, and to afford an outlet for the coal of the Daltonganj field to the north-east.

2. A considerable amount of goods from Daltonganj and Garwa is exported to Gaya and Maharajganj, from which places also the requirements of Palamow and Sirgujia are imported.

3. The branch leaves the main line at Sukhua, a village six miles from Daltonganj and 145¾ miles from Mogulserai. A preliminary survey was executed in 1879, but the project does not appear to have been matured. In the cold season of 1882-83, Captain Laugharne, E. G., made a reconnaissance of the country, and, without any knowledge of the existence of the previous survey, followed, almost mile per mile, the route selected in 1879, the only exception being a slight divergence between Sherghati and Gaya, the reconnaissance line avoiding the double crossing of the Jamna and its tributary.

4. A trial line was run by Mr. Luff in the cold season of 1883-84 *viâ* Chattarpur and Patan, but as the line would have been six miles longer than that originally selected, and involved gradients of 1 in 75 through the hills between Chattarpur and Daltonganj, this route has been abandoned.

5. The alignment located leaves the Sukhua station with a mile radius curve, and, running to the north-east, crosses the Jingoi Nulla at 5¼ miles, near the village of Sirma. It will probably be found advisable to correct the alignment between Sirma and Sukhua so as to join on to the main line east of the Jingoi Nulla, and thus avoid the construction of a second bridge.

6. The country is fairly easy, and gradients are 5 and 6 feet per 1,000 up to the 9th mile, where the line rounds the corner of the hill range which lies east and west, and runs down very nearly to the left bank of the Jingoi Nulla. For two miles some very rough and broken ground is passed over, and up to the 16½ mile the drainage from the hills, running into the Jingoi river, is crossed, the country being partially cultivated.

7. There is a continuous rise up to the 21¾ mile, Mannatu village, where the line crosses the ridge which borders the Ganges plain on its south side. The gradients are in short lengths not exceeding 8 feet in 1,000 with intermediate levels. With the exception of two short heavy banks, the work is not very expensive.

8. From the summit, which is 1,087 feet above mean sea-level, a continuous descent of 1 in 100 for five miles brings the line down into the valley of the Mohur river, crossing the Baludah Nulla, a tributary of the Mohur, on a level half a mile long. There is a heavy cutting at the top 1½ miles in length and from 13 to 48 feet deep. Near the bottom of the incline is a very heavy embankment for 1½ miles, the Bewalthar Nullah being crossed twice at a height of 48 and 42 feet above its bed. The double crossing is said to be unavoidable, owing to the sharp bend of the stream.

9. The cuttings are in hard gneiss rock, and will be expensive to work. The banks also will be expensive as soil is not easily procurable, and must be tipped from the cutting.

10. From the Baludah river, 26¾ mile, the work is comparatively easy, and gradients flatten off, the country improving up to the crossing of the Mohur river near Lokudi, at 33rd mile, which is 486 feet below the summit at Mannatu.

11. From the 33rd to 56¾ miles the line follows the course of the Mohur, and crosses several tributaries which flow into that river from the adjacent hills. The gradients are easy, but there is a good deal of bridging and comparatively heavy work. The country is undulating, partly under cultivation, with large patches of scrub jungle.

12. From the 57th mile to Gaya the gradients are light and the work easy. The grand Trunk Road is crossed at Gopalpúr, 1½ miles from Sherghati, mile 59; thence keeping west of the Jamna river, the line crosses it at mile 76, and joins in to the Patna-Gaya State Railway at the south end of the station ground, following the curve already laid out through Macleodganj, which is now enclosed by houses.

13. The length of line from Sukhra junction to Gaya is 80 miles, 1·96 chains. This is shorter than the original reconnaissance route, which was estimated up to Daltonganj. The probable cost, calculated from preliminary survey section, will be R67,39,013, or R84,238 per mile, which is probably a maximum.

14. The only trading towns on the route are Daltonganj and Raniganj, a mart on the east bank of the Morhur river opposite to Imamganj, which is simply a thana and postal station. At Sherghati there is but little trade. Raniganj is the central depôt for the south-western portion of the Gaya district.

15. It is estimated that coal can be landed at Gaya for R6-3 per ton, assuming the cost of Daltonganj coal to be R3-8 per ton at Sukhua station. The cost at Bankipur would be R6-14-6. The Giridih coal delivered at Gaya would cost R9-3 per ton, and at Bankipur R7-13-9 per ton. The saving in cost of coal at Gaya would be R3 per ton, and at Bankipur 12 annas 6 pie per ton, if Daltonganj coal be used.

16. The consumption of coal for 1882 on the Tirhoot and Patna-Gaya Railways is estimated as follows:—Tirhoot 4,000 tons, Patna-Gaya 3,000 tons. As considerable extensions are being made to the Tirhoot line, the consumption will probably rise to 10,000 tons before the completion of this projected branch railway: 10,000 tons may be also allowed for the Bengal-North-Western Railway now nearly completed.

17. The saving in cost of coal to these railways would amount to R25,062, thus—

Tirhoot, 10,000 tons	at R15-3	R 9,531
Bengal-North-Western, 10,000 tons	„ 15-3	„ 9,531
Patna-Gaya, 3,000 tons	„ 2-0	„ 6,000
	TOTAL .	„ 25,062

18. The carriage of 23,000 tons of coal at 4½ pie per ton mile over 80 miles of line would bring in R43,125. There would probably be also a traffic in firewood, as fuel is scarce in the Ganges Valley, while it is very abundant in Palamow.

19. In addition to these items Captain Laugharne shewed in his reconnaissance report that the general traffic in goods between Daltonganj and Gaya would probably amount to R5,713 per mile per annum, which, for 80 miles, would be R4,57,040 per annum, or R110 per mile per week.

20. These figures were obtained from statistics furnished by Mr. R. W. Renny, Assistant Commissioner of Palamow, and are in excess of the actual receipts for goods of the Gaya Railway for 1882; the total receipts of the Patna-Gaya Railway for merchandise in 1882 were only R1,75,540 for the year, which probably included the trade with Palamow. Considering that this trade is carried on principally by pack bullocks, Mr. Renny's figures

probably represent the trade of the whole district in every direction. A great deal goes to Maharajganj in the western part of Gaya district, which is a great depôt from which merchandise is again exported to the surrounding districts and to the East Indian Railway. This will probably be now diverted to Gaya.

21. It will probably be safe to take half the amount estimated by Captain Laugharne as the receipts from goods traffic, *i. e.*, R2,28,500, equivalent to a freight per annum of 8,22,600 maunds at two-thirds pie per maund per mile over the whole distance, and half of this may be be taken as extra freight to be carried over Patna-Gaya Railway.

22. The pilgrims for Gaya who would go on to Cuttack would probably travel onwards by the Benares-Cuttack Railway, as the distance to Chandil, where the line joins the Bengal-Nagpur Railway, is only 246½ miles against 335¾ from Gaya to Chandil by Bankipur and Sitarampur.

23. The passenger traffic of the Patna-Gaya Railway for 1882-83 produced gross receipts R3,64,762, which compared with receipts from goods traffic R1,75,540 is over 2 to 1. On other main lines the passenger traffic is from half to one-third of the goods traffic. The passenger traffic of the Patna-Gaya Railway must therefore be greatly increased by the pilgrims visiting Gaya. The average number carried per diem was some 1,700.

24. A large number of pilgrims do travel now on foot southwards from Gaya, who would probably take advantage of the proposed railway. Assuming that 500 passengers per diem travel from Gaya to Sukhua the receipts per annum at 3 pie per mile would be R2,23,125.

25. The total direct returns therefore would be R4,94,745 per annum, thus—

	R
Coal traffic	43,125
Goods	2,28,500
Passengers	2,23,128
TOTAL .	4,94,745

of which working expenses would be about R2,47,370, or 50 per cent. The balance R2,47,375 represents a return of 3·67 on a capital of R67,09,000.

26. The indirect returns would be R1,30,947, thus—

	R
Saving in cost of fuel on Tirhoot and other railways	25,062
Extra freight over Patna-Gaya Railway of 20,000 tons of coal at 4½ pie per ton per mile	26,719
Extra freight on Patna-Gaya Railway over 400,000 maunds carried 57 miles at ⅔ per maund per mile	79,166
TOTAL .	1,30,947

which is equivalent to 1·94 per cent. more on the capital to be invested, *i.e.,* the profit to the State would be 5·61 per cent.

27. An index plan and section accompany this report. The final estimate will be submitted on completion of the working drawings. The amount of this preliminary estimate is not likely to be exceeded.

Enclosure No. 5 to Railway Resolution No. 799 R.C. of 1887.

No. C. 150 W. R., dated 17th September 1884.

From—COLONEL J. O. MAYNE, R. E., Secretary to the Government of the North-Western Provinces and Oudh, Public Works Department, Railway Branch,

To—The Secretary to the Government of India, Public Works Department.

I am directed to acknowledge the receipt of your letter No. 772 R. C. of 3rd September 1884, forwarding a copy of a report and estimate on the Benares-Cuttack Railway Survey, with a map showing the alignment west of Gurhwa, and asking for an expression of opinion from His Honour the Lieutenant-Governor, North-Western Provinces, as to the alternative routes suggested for reaching Mogulserai.

2. In reply, I am directed by the Lieutenant Governor to state as follows. The two routes crossing the Sone River at the same site, *viz.,* Parcha, may be thus described:—

(1) From the north bank of the River Sone running along the banks of the river in a westerly direction for about 30 miles, then turning northwards and traversing a portion of the Ghazipur District, yet undevoloped, for some 45 miles, and then 25 miles well cultivated country, making a total length of 100 miles to Mogulserai.

(2) From the north bank of the river hugging the banks of the Sone in a north-westerly direction for some 40 miles, and then turning towards the west, would traverse some 60 miles of country already well developed and cultivated, of which only about 15 miles would lie within the limits of the Ghazipur District. The total distance to Mogulserai being about 105 miles. The two routes are practically the same length.

3. Route (1) practically serves the North-Western Provinces locally to the best advantage, whilst route (2) would traverse a more fully developed tract of country. The location, however, of so important a line demands consideration on a larger basis than purely local interests.

4. It is gathered from the report received that route (2) will be nearly a level line with easy work the whole way, whereas from former reports it is known that route (1) necessitates heavy gradients and difficult works.

5. The cost of the first section by route (2) excluding cost of bridge, it is also understood, will be about R 88,000 per mile against R 1,02,600, the estimated cost of first section per mile by route (1), so by adopting the former, a saving of some 10 lakhs will be gained.

6. Further, as a very heavy coal traffic is anticipated between Chota Nagpur and Mogulserai, rout (2) will possess very considerable advantages in allowing full loads to be hauled and thus keep down the cost of the coal.

7. Sir Alfred Lyall, therefore, whilst feeling that for provincial interests route (1) is so far preferable that it would open out and develope a tract of country now much shut off and land-locked for want of communications, considers that the larger views in favour of route (2) should prevail.

Enclosure No. 6 to Railway Resolution No. 799 R.C. of 1887.

Report by MR. H. GRAVES upon the First Division from Garwa to Rud.

Alignment.—In the first 30 miles (from Garwa) of this section the alignment is determined by the following considerations:—

(*a*) The necessity of passing through the Daltonganj coal-field.

(*b*) Selection of the best crossings for the numerous rivers and nallahs.

In fact it may be said that the latter consideration rules the location.

2. Commencing from Garwa with a square crossing of the Dauronaddi, the line proceeds on a bearing of 285° 10′ to the neighbourhood of Banpurwa at the 6th mile, from which curve No. 1 takes it into a straight run of seven miles across the Tuhleh nallah and its two sub-tributaries, the Amriti and Kankuria, to the 13th mile at Ledki, avoiding the heavy ravines just north of this village. Here curve No. 2 brings the alignment to a bund opposite the village of Pattria in the 16th mile, where a slight bend (curve No. 3) carries it square across the river Koel and into the heart of the coal-field.

From Garwa to the Koel river, the locations is abandoned, as the line from the north-west must keep to the north side of the Garwa hill, and joins Mr. Graves' location close to the Koel river.

W. H. P.

3. On the east bank of the Koel, curve No. 4, at mile 18, brings the alignment into straight run, the location of which, after a great deal of trouble, was effected, giving good crossings to the Jingoi nallah and its sub-tributary the Banka nallah. On this piece of straight is the Sukhua station at mile 19, from where the Gaya-Palamow branch takes off. At mile 22, on leaving the coal-field, curve No. 5 takes the alignment across the Amanat river and the Kundri nallah to mile 24½; here a bend to the left (curve No. 6) was necessary in order to avoid the ravines of the Maila nallah, and another curve to the right (No. 7), near Mundarria, at mile 26, gives a square crossing of that river.

4. At this spot some difficulty was experienced in effecting a location so that the crossing, which will not bear shifting either way, should not be altered, and at the same time the small tributary nallah to the east avoided. This was managed by putting in two small curves (Nos. 8 and 9) at mile 28½.

5. From here the alignment proceeds up the watershed between the tributary nallahs to curve No. 10 at the 30th mile. A bend to the left carries it to the neighbourhood of Barikhas at the 33rd mile, where curve No. 11 was necessary to avoid the hill at milli 35, curving No. 12, round which, in order to keep clear of the Maila naddi, it runs to curve No. 13 at the village of Ponchi (36½ mile). From here the line runs past Chatti Sathbarwa to the 38th mile, where a curve No. 14 is necessary in order to cross the hill range at mile 39½ at the lowest point consistent with a fair alignment.

6. On leaving this hill range, curve No. 15 at the 40th mile takes the line past the hillock north of Pipra through difficult ground covered with ravines to the neighbourhood of the Charwadih Hills at mile 42½. Here the location gave a great deal of trouble, the country being dotted over with isolated hills and hill ranges covered with dense jungle obscuring the view on all sides. On running the trial from Mankah, the lowest pass among the numerous hills was taken, and it was only on the return journey that, on obtaining a view from Charwadih Hill, it was seen that a line run straight from there towards Sinjoh, at mile 46, would in all probability avoid the hills as well as the village of Mankah through which the trial line ran. This was accordingly done, and the result proving favourable, curve No. 16 at Charwadih Hill was put in and the line taken straight to Sinjoh, where curve No. 17 carries it across the Sukri naddi at the 49th mile.

This crossing of the Sukri nallah is obligatory.

W. H. P.

* *

7. From here commenced the most difficult part of the alignment, the country for the next nine miles being nothing but rocky hills covered with dense forest. After crossing the Sukri, curve (No. 18) takes the line to the bank of the Auranga at mile 52, the country to the north being a mass of high hills, making it necessary to look for a route by keeping in the valley of the river. By a succession of curves Nos. 19, 20, 21, 22, 23, 24, the first three of which are of 1½° deflection, a practicable line was obtained, and the 57th mile reached on the heights north of and close to Latiahur. Here a curve (No. 25) carries the alignment past the village to curve No. 26 at mile 58½, and, avoiding the high ground to the north of the police rest-house, brings it into the Auranga coal-field. After crossing the Auranga river a turn (curve No. 27) to the left at the 61st mile is necessary to avoid the Gawa nallah.

8. From here the line runs up the watershed with a slight bend (curve No. 28) at the 63rd mile near Jalum, where it leaves the coal-field, to the 2nd crossing of the Auranga at the 65th mile. Crossing this river square to curve No. 29 at the 66th mile, it proceeds so as to avoid the numerous nallahs west of Keeta to mile 67½, from where curve No. 30 brings it through another small corner of the coal-field to the neighbourhood of Rud. The last curve (No. 31), the only curve of 4° deflection in the alignment, carries it into the prolongation of the first piece of straight in the alignment of the 2nd division.

This alignment has since been improved by connecting the location of this season with that of the valley alternative of 1884-85.

W. H. P.

9. *Gradients.*—The first 37 miles, *i.e.*, from Garwa to Sathbarwa, may be considered fairly easy, rising and falling with short grades until a total rise of 222 feet is accomplished at the latter station. From here there is a continuous ascent of one in 100 to Mankah in the 46th mile, broken in two places by a short stretch of level 3,000 feet long and a falling grade of 1 in 100 (for 1,200 feet) at Namudag. The total rise in this run of 10 miles is 340 feet. A more surface line avoiding the heavy embankment east of Sathbarwa could undoubtedly have been obtained by curving to the south from Sathbarwa, running along the north base of the hills shown in the working plan, and rejoining the line just before entering the pass through the hill range; but a considerable increase in the length of the line, together with the necessity of running over four extra curves of probably short radii made this improvement a doubtful one.

When marking out the line, it would be advisable to endeavour to effect this improvement which, from inspection of the plans, would appear to be very desirable.

W. H. P.

10. From Mankah to the Sukri at mile 49, the descent is made up of easy grades varying from 1 in 100 to 1 in 200, broken by a short stretch of level, the total fall being 102 feet. From the Sukri river the grades are much cut up, rise and fall abruptly, until the second crossing of the Auranga between Jalum and Kita (at the 65th mile), from where a rise of 1 in 100, broken by a stretch of level 1½ miles long, brings the line to the junction with the 2nd section at Rud, having surmounted 430 feet after leaving the level run over the Sukri bridge.

11. *Character of country.*—The country in the neighbourhood of Garwa, our point of departure, may be described as open and undulating as far as Banpurwa at the 7th mile. From this the ground is much cut up with deep ravines covered with dense jungle on the banks of the Tuhleh nallah and its tributary the Amirti nallah, after a break on the east bank of this latter stream, where a new village, Goriadamar, has sprung up.

12. The dense jungle and ravines are again continued across the Kankarria to within a short distance of Ledki at the 13th mile. The country is now open and under cultivation as far as the west bank of the Koel river, where ravines are again met with. From the east bank, with the exception of the plots which immediately surround the villages, and have been brought under cultivation, the same ravines continue, becoming very heavy in the neighbourhood of the Jingoi and Banka nallahs at the 21st mile, where great difficulties were experienced from the dense jungle consisting of Khair trees, the branches of which are interwoven with creepers.

13. From the 21st mile to the west bank of the Amanat river, the land is cultivated, but jungle again stretches from the east bank of this river across Kundri nallah into heavy ravines in the neighbourhood of the 25th mile, from where a couple of miles of rice cultivation bring us to the difficult ground near the Maila river and its tributaries. Here nothing but jungle and ravines is seen until, on reaching the 32nd mile, the country again becomes open near Barikhas and up to Sathbarwa.

14. From Sathbarwa to Latiahur, a long stretch of 20 miles, the most difficult ground is met with, especially between the Sukri nallah and Latiahur, where low hills, covered with dense forest, made the location of a practicable line a matter of great trouble and difficulty.

15. From Latiahur to the junction with the 2nd division at Rud alternate patches of jungle and cultivation are found, with the exception of the neighbourhood of the Auranga river, the banks of which are cut up with ravines and covered with jungle.

16. There are in this district miles and miles of country which, although very uneven, could be brought under cultivation. Wherever this has been done, the new settlers have,

owing to the excellent quality of the soil, been rewarded with luxuriant crops of wheat and gram, &c.

17. *Waterways and sites of river-crossings.*—There are altogether 193 bridges and culverts on this section. Excluding the larger bridges, 123·2 square feet of waterway have been allowed per mile of line, and taking the larger bridges into account, this item is raised to 1,192 square feet.

18. The amount of waterway in running feet per mile is as follows :—

Major bridges . .	Feet 56·3	Total 78·7 running feet per mile.
Minor bridges . .	„ 22·4	

19. The foundations of the minor bridges and culverts present no difficulty whatever, rock being found throughout in the bed, or with only a thin layer of 3 or 4 feet of sand and gravel overlying it.

20. The major bridges (*i.e.*, of more than 60 feet waterway) of this section are nine in number, and the rivers for which they provide waterway are as follow (showing depth of rock below bed) :—

River	Depth of rock below bed.
Dauru	4'
Tuhleh	Rocky bed.
Koel	25'
Jingoi	Rocky bed.
Amanat	15'
Maila	8'
Sukri	6'
Auranga, 1st crossing	8'
Auranga, 2nd „	8'

Rock crops up in the banks of all at the crossings, so that the abutments would in all cases have rock foundations about bed level; the beds themselves also show rock cropping up here and there except in the beds of the Koel, the Amanat, the Maila, and the second crossing of the Auranga.

21. The following notes were taken of the various streams at the railway crossings :—

Dauro Nullah, 9 spans of 40 feet, mile 1.—The spot selected, which gives a square crossing, is the only one (north of the sharp bend) where rock exists throughout in the bed, and where the breadth of the stream is a minimum.

Tuhleh Nallah, 10 spans of 40 feet, mile 8½.—The banks at the crossing are high and well-defined, and the stream narrower here than elsewhere.

Koel river, 14 spans of 100 feet, mile 17.—A mile above the crossing, the Koel is joined by the Amanat, and the cross action of the waters of these two rivers is such that considerable erosion of both banks takes place, except at one spot where it is prevented by the presence of rock, by which the stream is necessarily confined within the narrowest limits. This spot has been chosen for the crossing.

Jingoi, 5 spans of 40 feet, mile 21.—This stream is similar in all respects to the Tuhleh Nallah, both having a fall of between 13 and 14 feet per mile, and showing the same huge gneiss boulders in the bed. Some difficulty was experienced in obtaining a good crossing of this stream and its tributary the Banka Nallah combined.

Amanat, 7 spans of 100 feet, mile 24.—This river is a tributary of the Koel, and joins it one mile above the crossing of the latter. The spot at which the trial line crossed being found unsuitable in consequence of its breadth, another point, a mile further down, was chosen, and a saving effected of from 300 to 400 feet of waterway. The stream here is confined between high banks and shows rock on both abutments, stretching well out towards the centre of the bed.

Maila Nallah, 5 spans of 40 feet, mile 28.—The crossing of this stream is square, and the banks high and well-defined.

Sukri Nallah, 9 spans of 40 feet, mile 49.—The line crosses just below the junction of this river with the Kurkut Nallah, and the spot was necessarily fixed by the alignment on either side.

Auranga, 1st crossing, 3 spans of 60 feet, mile 60.—The crossing of this river, which was fixed to a great extent by the necessity of avoiding the hills to the north-west and the Gawa Nallah, is almost square, and the bed and banks are all rock.

Auranga, 2nd crossing, 4 spans of 40 feet, mile 65.—The crossing here is square, and the banks high and well-defined.

22. *Station sites.*—The stations on this section are as follow :—

1. Sukhua	Mile 19
2. Kodelwar	„ 30
3. Sathbarwa	„ 37
4. Manka	„ 45½
5. Latiahur	„ 57½

23. *Sukhua* is an engine-station, and the junction with the Gya-Palamau Branch. It is on a straight run, 1,400 feet of level in the centre, and the remainder, 800 feet on the west and 1,150 feet on the east, on falling grades of 1 in 200. Its situation is about the centre of the Daltonganj coal-field, and two miles from the Singra workings, from which the supply of coal is at present derived. It would also be the station for Daltonganj, which is 6½ miles distant. Water for the engines would be got from wells, the depth to which they would have to be sunk to hold 15 feet of water being 35 feet.

Chattar station has since been added to this list.
W. H. P.

24. *Kodelwar* is a third class station, the whole length on a curve of 1° deflection and on a falling grade, from south to north, of 1 in 500. The engine-well would here have to be sunk through 50 feet of hard soil and rock.

25. *Sathbarwa* station is close to the large village of Sathbarwa, at the foot of the ascent leading to Manka and on the road from Ranchi to Daltonganj. It is a third class station, and the water-level is at about 15 feet from the surface. The well would therefore have to be sunk 30 feet. The alignment here is on the straight and formation all on the level.

26. *Manka* station (third class) is close to the large village of that name, and on the main district road. The engine-well would be sunk 30 feet. The alignment is on the straight and level, with the exception of 940 feet at the west end, which is on a grade of 1 in 100. This will, however, not effect the level of the station yard, as the ground will allow the sidings to be run out on the level without embankment.

27. *Latiahur* is a third class station close to the village of Latiahur, where a considerable trade in grain is carried on. The alignment is straight and the station ground level throughout. The engine-well would be sunk 30 feet. This station is situated on the western edge of the Auranga coal-field and 3½ miles from the village of Gawa, which is close to the line, and is mentioned in the report of the Geological Survey as one of the likely spots where good coal would be found.

28. *Material available and rates.—Building-stone* of good quality, but difficult to work, is to be had from the Banda and Sanpurwa Hills, about four miles north of the village of Garwa, and also directly on the line on the banks of the Tuhleh river; also two miles north of the line between the villages of Maddia and Lakhna. Sandstone fit for building is found at Kotam Raj hill, eight or nine miles south of Garwa.

29. The sandstone of the Daltonganj coal-field, *i.e.*, all within the area of the coal-bearing strata, does not appear to me fit for building purposes; its texture is granular, coarse, friable and earthy; a fair stone is obtainable outside this area near the village of Pokraha, about seven miles sourth-east of Daltonganj, as also in the neighbourhood of the Maila river crossing at the 28th mile. At this point the crystalline series is met with, and rocks of granitic gneiss are found all along the line at intervals as far as the Auranga coal-field, which commences about a mile east of Latiahur.

When construction is put in hand, further search will probably show that sandstone fit for building purposes can be obtained.
W. H. P.

31. A great deal having been heard of the stone in the Palamau forts, I paid the latter a visit. They are built on isolated hills, and were in former days the stronghold of the Rajahs of Palamau; to judge from the height (in some places 90 feet) and thickness of the walls, they must have been almost impregnable; they are now in ruins and overgrown with dense jungle inhabited only by wild beasts. The walls are made of stone and brick indiscriminately mixed and cemented together by a profusion of the best mortar. In the jambs and soffits of some of the gateways are large slabs of beautifully-dressed stone, eminently suitable for girder-bed pieces; one I measured was 8′ x 1′ 8″ x 8″. Amongst the ruins were found most exquisite carvings as sharp and well-defined as if they had only just been executed, notably the brackets of a balcony over one of the gateways, each bracket containing the figure of an elephant carved in full, its size being only about 1′ 3″ long by 9″ high.

32. The stone used is apparently a crystalline limestone almost approaching quartzose in hardness, but capable, as shewn by the above-mentioned decorations, of bearing the most delicate chiselling. Another slab measured 6 feet square by 8 inches thick, hewn in the form of a *dais*; the body, to a depth of 4 inches, being chiselled out underneath, leaving eight pedestals at exact intervals of 2 feet round the outer edge of the slab.

33. The same remark, as regards the unfitness for building purposes of the sandstone of the Daltonganj coal-field, applies also to the Auranga field; all specimens that were obtainable shewed the same coarse, friable texture, and broke off easily under the hammer. Some large slabs were found upright, embedded in the soil 500 feet west of the village of Kinanmand; one of these measured above ground 11′ x 3′ x 1′, but the quality of this stone would render it useless in such a position as the lower courses of the pier of a large bridge, as it would crush under the superincumbent weight.

34. Outside the area of the coal-bearing strata, however, at the junction of the latter with the metamorphic rocks, near Kurkut about mile 53, this soft friable texture is lost, and good building-stone can be obtained. It is, of course, a matter of future enquiry as to whether, on opening out a quarry within the area of the coal-field, better material would not be found than shown on the surface, from which the specimens inspected were taken. Should this be the case, an extensive supply could be obtained from the low hill running parallel to the line and within a few hundred feet of it near mile 57, the bed of the sandstone being normal to the hill face, and therefore easily detached in large blocks.

35. From here to the junction with the second division at Rud the supply of building-stone would necessarily be obtained from outside the coal-field, or as nearly as possible along the line taken by the reconnaissance, in the neighbourhood of the Auranga near the village Sose, and in the adjoining hills.

36. To conclude on this head, it would appear certain that the crystalline rocks which are distributed over most of the Palamau district constitute the source from which the supply of building-stone will be mostly derived when the work of construction is commenced; and although the material is hard and rather difficult to work, there can be no doubt as to its superior strength and durability.

37. *Lime* of good quality can be manufactured from the Kunkur nodules which are found in any quantity along the line between the terminus at Garwa and the neighbourhood of Maila river at mile 30. The stone found in the beds of the nallahs enumerated in the margin also appears to be calcareous.

Birka nallah, Kundri nallah and Banka nallah.

38. On the north bank of the Auranga, between Patki and Latiahur, among the metamorphic rocks, is found a deposit of limestone yielding a pure white lime suitable for white-washing; the extent of this deposit laterally is not known; it shows the following sections:—

Earth above	3 feet thick.
Limestone proper	1½ „
Ditto mixed with quartz and felspar and clay . . .	3 „
Sand and grit	depth unknown.

This limestone is also found in the neighbourhood of Semri, three miles south-west of mile 61 of our line.

39. Kunkur nodules are found at about 2 feet below and occasionally on the surface of the ground within the area of the Auranga coal-field. There are none to speak of between it and the Maila crossing.

40. The geological survey refer to a very superior limestone between Olherpat and Deridag on the Balumath-Chattra road, and the spot was accordingly visited. The deposit is about five miles off this road due west from Balumath, about half a mile south-west of Deridag, on the southern edge of the country mentioned by the geological survey as being peculiarly rich in iron-ore It appears to me very similar to the deposit found on the banks of the Auranga near Hutwag, and again at Semri, both of which have been alluded to in this report The limestone at Deridag crops up out of the ground in masses rising to a maximum height of 6 feet, and having an aggregate area of about a mile square. Beyond these limits it disappears beneath the surface of the ground, to what extent is not known. The supply would seem practically unlimited.

41. I also found a crystalline limestone four miles from Chandwa on the road to Balumath, but cannot state as to its quality, although it effervesces freely under the action of hydrochloric acid.

42. *Timber* may be said to be an unknown quantity on this section; there are extensive areas occupied by sâl forest, but none of the trees are even large enough to yield a sleeper of good quality. The permanent-way might derive their supplies to a certain extent from the Sargujia forests, but the Chaibasa district would appear from all accounts to be the depôt of the future.

Unlimited in quantity, but inferior in quality.
W. H. P.

43. Since writing the above, I met with, at Chandwa, about twenty sâl logs that were said to have come from the Surju forest, 12 miles south-west of Latiahur, and were on their way to the railway at Sahibganj (Gya). The logs were rough-hewn, and about the size of broad and narrow gauge sleepers, but their shape was so irregular that a square sleeper, 5 inches thick, certainly could not have been got out of them. The wood seemed finer and closer grained than the Nepal sâl, but there was a good deal of sap.

44. *Iron-ore* exists in large quantities all over the district except within the limits of the coal-bearing strata, and numerous signs of iron-smelting having been carried on formerly are met with. I came across slag in several places where now there is nothing but dense forest, without a sign of a human habitation: in one instance, notably on the banks of the Auranga, near the spot where the deposit of rich limestone has been also discovered.

45. The rates of materials which at present prevail are as follow :—

	Rs.	A.	P.
Ashlar, dressed at quarry, per cubic foot	0	12	0
Stone, rubble, at quarry, per 100 cubic feet	2	0	0
Bricks, 1st class at kiln, per 1,000	11	0	0
Lime, kunkur, at kiln, per 100 cubic feet	12	0	0
„ stone			
Flags, stone, at quarry, per 100 square feet	10	0	0
Ballast, kunkur, at site, per 100 cubic feet	2	0	0
„ stone „ „	3	0	0
Timber, in scantling, per cubic foot	1	12	0

46. *Daltonganj coal-field.*—The only spots where coal has been got out are as follow :—

I.—*Rajhera*, right bank of Koel, two miles above Gaddikhas.

II.—*Pandua*, 1½ miles east of Rajhera.

III.—*Singra*, at the confluence of the Koel and the Amanat rivers.

Rajhera and Pandua were worked by the Bengal Coal Company, the material being obtained by surface workings principally. There is one shaft at Pandua, 13 feet in diameter, now full of water, the mouth of which has been entirely closed by jungle. The coal lying on the ground from the old workings is now being picked and carted to Daltonganj, where it is used for burning bricks.

47. At Singra several shafts have been sunk; they are all full of water except one, from which Mr. Hodges, a resident of Daltonganj and proprietor of the land, has been extracting coal since the year 1882. About 60 feet from the surface, a seam 12 feet in thickness is met with. The material has been used for locomotive purposes, and appears to be fully equal to the Raniganj coal.

48. *Auranga coal-field.*—There are several out-crops of coaly shale in the Auranga and its tributaries near Jagaldagga, but very little workable coal appears.

49. *Labour available and rates.*—Skilled labour of all kinds would be obtained from the Dehri canal, Sasseram, and the stations north, as Mirzapur, &c.

50. There being comparatively so little cultivation throughout the Palamau district, the indigenous labour could not be relied on to any extent, and regular excavators would therefore have to be imported. The rates of labour are as follow :—

Coolies, per diem	2 annas.
Bullocks	3 „
Carts (carrying 8 maunds each)	8 „

51. *Market and traffic.*—The principal marts in the Palamau district are—

Garwa.
Daltonganj.
Sathbarwa.
Latiahur.

Manka, although a large village, does not possess a trade of any importance.

52. The exports are lac, *harri* (a dye expressed from the seed of the tree of that name, and exported in large quantities from the Government waste lands), til-seed, wheat, fuller's earth, *geru* (a mineral dye), *gur*, horns, hides, iron in large quantities, also cotton to some extent.

The imports are piece-goods, salt, tobacco, and utensils.

Enclosure No. 7 to Railway Resolution No. 799R.C. of 1887.

Report by Captain M. LAUGHARNE, R.E., Executive Engineer, on the North-West Provinces Division.

THIS division commences at the Mughalsarai station of the East Indian Railway, which is the proposed starting point of the Benares-Cuttack line, and extends to the left bank of the Koel in Palamau, where it joins the first survey division located in 1883-84, its length being 143⅝ miles. The original intention was for this line to pass through the Kaimur range to Palamau, but this idea was abandoned; the line now skirts the range on the north and east.

Alignment and character of Country.

2. The first 63 miles of the line from Moghalsarai to Sasseram pass over a flat, open plain, and are laid out as straight as possible in a south-easterly direction, deviations only being necessary to obtain suitable and rectangular crossings to the Karamnassa and Durganti rivers, and to avoid the many villages which are thickly scattered over the country

3. The line leaves the East Indian Railway with a curve of 66 chains in length and 7,640 feet radius, and commences 790 feet from the distant signal of the Moghalsarai station, or 468¾ miles from Calcutta.

4. The Grand Trunk road is crossed on the 6th mile, and with one slight curve on the 8th mile the line runs on the straight to the 14th mile, where the Karamnassa river is crossed, the site selected for the bridge being at the lower end of a fairly long, straight reach with well-defined clay banks, below which the river winds considerably: the choice for the crossing was limited by the confluence of the Chandarprova nullah with the main stream just above the site selected. After continuing on the straight for another 4 miles, a deflection of 19° to the south enables the line to run almost direct to the Durganti river, skirting the large and important village of Bhabua on the south, which is at present the most important place in this part of the Shahabad district.

5. There are three fair-sized nullahs that have to be passed in this portion of the route—the Gauhua, Kora and Sura—requiring 4 openings of 20 feet, 4 of 40 feet, and 3 of 60 feet, respectively, and in constructing the line it will probably be advisable to alter the location so as to cross the latter nullah on the straight.

6. The next point of importance in the alignment was the crossing of the Durganti river, whose banks are much cut up with ravines and whose course is very devious. A fairly long, straight reach was found, and a point selected where the banks were better defined and the ravines less prominent. A deflection of 31° to the north was rendered necessary to bring the line at right angles to the river course, followed by a reverse one of 36° to the south to regain the general direction, and keep the line to the south of the Kudra nullah, which throws out a sudden bend southwards about the 57th mile of the line. The straight on which the river is crossed between these two curves is 4,400 feet. Between Bhabua and the Durganti there is a stream necessitating a bridge of 3 spans of 40 feet on mile 37, and on the east of the Durganti a bridge of 4 × 20 feet is required on mile 51, and 1 of 3 × 40 feet on mile 52 over the Dharmsot nullah.

7. On the 57th mile the line deflects 29° to the north, and runs to the mouth of the Kota pass, which is situated between the main Kaimur range and a detached hill. Just before entering this pass the station for Sasseram, about two miles south of the town itself, is situated.

8. From Moghalsarai to Sasseram the country is, as has been stated, very level, there being a total rise of 100 feet in the 62 miles, and the gradients being very easy, none steeper than 1 in 400 occurring, except for half a mile before Sasseram station, where the gradient is 1 in 250.

9. The line is all embankment, 75 per cent. being under 10 feet in height and only a few chains being over 20 feet. Though the ground is so flat, the line cannot be carried on the surface, as a certain amount of height is necessary to raise the line above the flood level, the minor waterways required being considerable. The major streams are few in number, and, except the Karamnassa and Durganti, there are no deep water channels to take off the drainage from the Kaimur range, which seems to spread over the country generally, and to be retained by the cultivators by long bunds over which the formation has been carried.

10. This portion of the line passes through a well-cultivated and thickly-populated district, the principal towns of which are Sasseram and Bhabua. In laying out the line through the Kota pass, the upper part was fixed by the necessity of taking the line in the gap between the two hills and on the south of the Kudra stream, so as to avoid interference with the road, which runs just on the other side of this stream at the pass. To allow of a ruling gradient of 1 in 200, a bank, some half mile in length and 25 to 35 feet in height, will be necessary, and a short cutting in sandstone rock at the lower end is necessitated to keep the line clear of the stream, which runs in a considerable hollow.

11. The double crossings of the nullah shown in the centre of the pass might be avoided, either by deflecting it and keeping it entirely to the north of the line, or else by introducing two extra curves and running the line as shown, dotted in red, in the plan, which would reduce the height of bank necessary.

12. After emerging from the pass, the line skirts the base of the hills, and on mile 66-67 turns sharply to the south, with two curves of 30° and 26° deflection, with a short straight of 800 feet between them; and after 1½ mile on the straight another deflection of 42° 30° on the 69th mile brings the line parallel with the Son, up the left bank of which it runs to the 105th mile until a suitable crossing is met with.

13. Near Rhotas the line passes between the main hill and a small detached hill, it being found that the country on the river side of this hill was liable to inundation.

14. From the top of the Kota pass to the 83rd mile the ground is open, level and well cultivated; the line being mostly in bank, the greater part of which is under 10 feet in height: the same necessity is experienced for providing abundance of minor waterways as over the first portion.

15. The Kota ghât is ascended with a gradient of 1 in 200 for a little over one mile, but the remaining gradients are very easy up to the 84th mile: the line is continued up

the valley of the Son till the 104th mile is reached, the Ausoni being crossed on the 88th mile with a bridge of 3 spans of 60 feet. The ground is undulating and less cultivated than over the previous portion of the line, considerable patches of thick, thorny jungle being met with. This portion of line is principally in light bank with a few slight cuttings: there are no waterways of importance and the minor ones are better defined.

16. The crossing of the Son has been selected at a point above the junction with the Koel, where the river narrows and rock crops up on the surface at the right bank (and from borings taken was found to dip to about 35 feet below water level in the centre, rising to 22 feet on the left bank). In order to cross the river the line bends sharply to the south with a curve of 75 chains in length, the deflection of the curve being 1° per chain: the formation is carried over the river at a height of 20 feet above high flood level and about 48 feet above the bed of stream.

17. The waterway allowed is 27 spans of 150 feet each, and the approach on the west is by a bank some 20 to 30 feet in height. After crossing the Son the line is carried up the valley of the Koel to join the line located from Garwa to Daltonganj, with which it unites just before the latter crosses the river.

18. The line is carried between the river and a series of detached hills which border it. The Paknaha nullah with a waterway of 3 spans of 40 feet is crossed on the 113th mile.

19. The Banki river is crossed on the 118th mile with a bridge of 8 spans of 60 feet: this crossing is on the skew, but a better crossing could not be obtained. There is a considerable amount of jungle between the Son and the Banki; the ground is undulating and in many places intersected with deep gullies and ravines.

20. A heavy bank above 25 feet high is required on the 108th and 109th mile in order not to exceed the ruling gradient of 1 in 200, and a hard rock cutting, ¼ mile long, is met with on the 118th mile. After crossing the Banki the line continues on the straight to the 124th mile where it deflects 31° 11′ to the east and continues on the straight to the 135th mile, where it deflects 43° 44′ more to the east to cross the Tahli nullah at right angles.

21. The Danru is crossed on the 131st mile with a bridge of 7 spans of 60 feet. Between the Banki and the Danru there are a considerable number of streams to be crossed, the—

Bichli	on mile	123	taking	2 spans of	60 feet.
Phalarni	,,	125	,,	1 span ,,	80 ,,
Kunilwah	,,	126	,,	2 spans ,,	25 ,,
Bhagi	,,	127	,,	2 spans ,,	25 ,,
Gura	,,	130	,,	1 span ,,	60 ,,

This latter stream will require diverting so as to reduce the bridging required. Rock will probably be found at no great depth for the foundations of all these bridges.

22. The ground over this portion of the line is undulating, and several lengths of 1 in 200 will be required. A bridge of 60 feet will be required, for the Udra nullah on 133rd mile.

23. The Tahli nullah is crossed on the 136th mile with a bridge of 10 × 40 feet span, and the Kankaria on the 138th mile with 2 of 60 feet After which the line runs over tolerably level ground to its junction with first division, located in 1883-84, joining it with an easy curve at chain 86,940, 143⅝ mile from Moghalsarai and some 3,000 feet from the crossing of the Koel.

Waterways and river crossings.

The waterways in this division are of considerable extent: the line runs across the drainage of the country for its entire length. The major bridges of 100 feet span and over are 14 in number.

The Karamnassa, which is crossed on the 14th mile, requires a bridge of 4 spans of 100 feet and two flood openings of 40 feet. The site selected for the crossing was chosen for reasons given under description of alignment: the banks are well defined and consist of a stiff clay, which also underlies the sand in the bed at a depth of about 12 feet in the centre. The drainage area of this river is 1,053 square miles, and the raise of flood above water level is 30 feet, the declivity of bed per mile being 1·66 feet. The pier will be on wells.

The Kora nullah on the 29th mile necessitates a bridge of 4 spans of 40 feet: the drainage area of this stream is 73 square miles, and rise of floods 8 feet.

The Sura nullah 33rd mile, is crossed on the skew, and it will probably be advisable to alter the alignment so as to obtain a square crossing: the drainage area is 162 square miles, the declivity of the bed 1·9 feet per mile, and the rise of the flood is reported to be 15 feet, which shows it to overflow a considerable tract of country. The pier will be on wells.

The Bhabua nullah on 36th mile has a drainage area of 32 square miles, and a bridge of 3 spans of 40 feet has been allowed. Owing to bunds, &c., it is difficult to ascertain the real flood level and area of these three streams.

The Durganti, mile 48½, requires a bridge of 4 spans of 80 feet girders, and two land openings of 40 feet. The selection of site has been described under alignment; the banks are of stiff clay and well defined; the drainage area is 322 square miles, and the flood rises 30 feet; declivity of bed 2·9 feet per mile. The piers will be on wells.

The Dharmsot on mile 52½ takes a bridge of 3 spans of 40 feet. The drainage area is 57 square miles, and the rise of flood 15 feet. The banks are of clay.

The Ausani, mile 87, has a drainage area of 50 square miles, and the flood rises 18 feet. Three spans of 60 feet are required. The stream will probably be diverted into an old channel more on the square with the line than the present one, and into which there seems a tendency for it to cut naturally. The foundation will be on rock, which will probably be found some 10 feet below the bed of stream.

The Son.—This river drains an area of 20,040 square miles: in the cold seasons the depth of water is about 9 feet and breadth about ¼ mile, but in the rain the flood rises 26 feet, and a bridge of 27 spans of 150 feet each has been provided.

At the site chosen for the crossing, which is about 9 miles above the junction of the Koel, the river narrows somewhat, and rock crops out at the surface on the right bank, giving a favourable abutment. The rock was found from boring to dip to a depth of 35 feet below the surface in the centre. The pier will be on wells carried down to this rock.

The Paknaha, mile 112½.—This nullah requires a bridge of 3 spans of 40 feet with land arches: the pier will be founded on rock; the drainage area is 26 miles, and the rise of flood 10 feet.

The Banki, mile 118, is crossed on the skew, but it is impossible to get a more favourable crossing: 8 spans of 60 feet will be required; rock crops out at the surface on the right bank, and probably exists at no great depth on the left bank. The rise of flood is 17 feet.

The Bichli, mile 122¾, requires a bridge of 2 spans of 60 feet with land arches. Rock exists at no great depth. The rise of flood is 6½ feet.

The Danru, mile 130½, requires a waterway of 7 spans of 60 feet each: the drainage area is 200 square miles; the rise of flood is 13 feet; rock probably will be available for foundation at a depth of 12 feet.

The Talheh, mile 136, requires a waterway of 10 spans of 40 feet: the banks are well defined, but low rock crops out on the surface at the left bank, and foundation will rest on it at a depth of about 12 feet: the drainage area is 136 square miles, and the height of flood 17 feet.

The Kankaria, mile 137, is crossed with a bridge of 2 x 60 feet land arches. Rock does not exist here, and the foundation will be on wells 20 feet below the bed.

Station sites.

1. *Moghalsarai*, junction station.—The ground for this station will be in extension of that occupied by the present station of the East Indian Railway, which is about to be enlarged as a junction for that line with the Oudh and Rohilkhund Railway.

The position is rather confined on the northern side owing to a large tank and village, but there is ample room on the south of the line. The curve at the junction has been laid out with a deflection of 45 feet per chain, which can be sharpened to give more room, if found necessary.

2. *Majhwar*, mile 9½, is situated near the large village of Chandali on the Grand Trunk road, the ground being open and level.

3. *Govindpur*, mile 18⅜ (water).

4. *Bhadari*, mile 28⅛.

These two stations divide the distance between Majhiwar and Bhabua, and are in open and level ground.

5. *Bhabua*, mile 34½ (goods and water), is near the village of that name, which is the principal mart for the produce of the Kaimur range: the site presents no difficulties.

6. *Nawadih*, mile 44⅞.

7. *Maldahar*, mile 53⅛ (water). The stations divide the distance between Bhabua and Sasseram, and are in open and level ground.

8. *Sasseram*, mile 62⅝ (goods and water), is situated 1½ mile to the south of important town of the same name on a gradient of 1 in 500, and just before the line enters some raviny ground at the entrance to the Kota pass.

9. *Tilothu*, mile 75 (second class and engine). This station is situated half-way between Moghalsarai and Sukhua (where the Gya-Palamau branch joins the main line), and has been selected as an engine station: it is near the village of the same name, which is of some size and stands in open and level country.

10. *Rhotas,* mile 86⅜ (goods and water)—This station is at the foot of the Kaimur range, below the old fort of Rhotas, and near the thriving village of Akbarpur.

The formation is on the level, but on a curve of 1° deflection.

11. *Jaitipur,* mile 95⅝, is situated in open rice cultivation, and is the last station on the left bank of the Son.

12. *Mainabar,* mile 107⅞ (water)—Is situated on the right bank of the Son, on the only available piece of high ground in the neighbourhood: the greater part of its length is on a gradient of 1 in 400.

13. *Munjianwan,* mile 121⅛—Is about two miles from the large village of the same name on the bank of the Koel, and is situated at the end of a long incline of 1 in 200, the station ground being ⅓ on the level and ⅔ on a gradient of 1 in 400.

14. *Garwa road,* mile 128⅜ (goods and water)—Is situated about four miles from the village of Garwa, one of the most important marts in Palamow: the site selected for the station is in open country, and the formation on the level for most of its length.

15. *Korta,* mile 136⅞—Is the last station in this division of the line, and is situated on the only available piece of high ground between the Tahleh and Kankari nullahs. The formation is for the most part on the level.

Labour and Materials.

Throughout the Benares and Shahabad districts, that is, for the first 104 miles of line, the country is well populated, and plenty of unskilled labour would be available. Round Sasseram masons could also be obtained, but after crossing the Son the population is scanty, and labour of all sorts would probably have to be imported. The rates for unskilled labour in the Shahabad district are 2 annas to 3 annas per day; masons and carpenters receive 4 annas to 6 annas. Kunkur and clay for bricks are obtainable throughout the line, and the Kaimur hills, which border it, consist almost entirely of red sandstone of an excellent building quality. There are Government quarries used for the Son canal work at Dhodhand, and a tramway connects them with Dehri. Limestone is also obtainable at many spots at the edge of the hills. Timber for sleepers would have to be brought from Palamow.

Markets and Traffic.

The principal villages are Chanudali on the 9th mile, situated on the Grand Trunk Road and a place of some size. Chenpur, some 4½ miles to the south of the 30th mile, has a population of 4,000, and was formerly a place of some trade, which seems recently to have been diverted to Bhabua on the 36th mile, which is stated to have recently much increased in size, and to be the principal market to which the produce of the Kaimur hills is brought. Chinari, near the 50th mile, is said to be another mart for hill produce. Sasseram on the 63rd mile is a town of over 20,000 inhabitants. The imports of Sasseram are stated in Hunter's Statistics to be 95,698 maunds, valued at R1,98,553, and the exports 35,253 maunds, valued at R66,603. Tilothu on the 76th mile is a thriving village, and Akbarpur on the 87th mile has about 2,000 inhabitants, but from thence to the end of the division there are no places of importance until Garwa is reached, which is the principal trade centre of the Palamow district, and is situated about four miles from the line and at a distance of 128 miles from Moghalsarai.

Enclosure No. 8 to Railway Resolution No. 799R.C. of 1887.

Report by Mr. E. C. HAWKES, Temporary Engineer, on the West Damuda Division.

General.—The preliminary survey was in the first instance ordered to be made up the Damuda valley, from Ramgarh to Rud, a distance of about 59½ miles, keeping along the south side of the Damuda river, locally called Deonad, as far as the village of Dumerbera, and thence along the north bank to Rud. This was carried out, but on an inspection of the country on the south bank by the Engineer-in-Chief, it was decided to make the crossing of the Damuda at Ruhbea, from which point fresh trial surveys had to be made for the purpose of the location, resulting in getting a better section, better gradients, lighter work and in a saving of 1·79 miles in length. The selection of the line was limited with respect to the gradients and curves: the former had not to exceed 1 in 100 and the latter were not to be sharper than 2,865 feet radius.

The located line starts from a point on the first section of last year's located line, *viz.*, chainage 3,698·42 near the village of Rud, and passes to the north of Chandwa, where it enters the Damuda valley, and thence to Ramgarh, following the valley, which lies to the north of the Ranchi plateau.

The line passes through both the Lohardagga and Hazaribagh districts, and there is every reason to believe that the principal traffic from these districts would in time be attracted to it.

Alignment.

Starting from Rud, at a point 197 miles 9·34 chains, from Mogulserai, the line takes a slight turn to the left, by a curve of 5,730 feet radius, and crosses the Gagri nullah on the square, thus avoiding the sharp curve of 1,433 feet radius, which occurs on the line as located last year. The crossing of the Gagri at this point was advantageous for the climb up to the Koel-Damuda watershed. Shortly after leaving Rud the valley becomes very steep, the ground being much broken up by ravines and covered with jungle, and is surrounded by hills. To the right of the Gagri the ground seemed particularly broken up and hilly, and the windings in the nullah projected awkwardly on that side. The alignment was carried winding along the left bank, where the ground was comparatively clear. Moreover, this side was more cultivated, and the line more direct than if carried to the right of the nullah, and by following a rising contour of 1 in 100 the ascent is made with comparatively light work. The height to be overcome was 173 feet, while the distance was barely sufficient, necessitating several trial lines and numerous cross sections. The level of the watershed here reached is 1,728 feet above the level of the sea, and is the highest point crossed by the line between Mogulserai and Chandil.

The country now opens out into the extensive fields of the Tori pargannah, is well cultivated, and studded all over with villages; the ground is gently undulating, and the gradients favourable (1 in 125 to 1 in 500).

After a stretch of three miles over this open space, the country falls rapidly towards the Lohsingna-Murmur nullah on the east and the Damuda on the south, and it was necessary to try several possible routes, resulting in the selection of the most northerly, which is also the most direct line. The route to the south of Mahawa Milan was found impracticable for a grade of 1 in 100. The located line follows the course of a nullah the whole way till the valley is crossed near the village of Murmur. The double crossing of this nullah could not be avoided owing to an awkward bend occurring in close proximity to the low range of hills which skirt the south bank, right down to the Lohsingna-Murmur river.

The next three miles (206½ to 209½) runs along a cultivated strip between the lower Sulaia Hills and the Damuda: it is raviny, and slopes off rapidly towards the river. At the 209th mile the hills rise up abruptly from the Damuda, making it obligatory for the line to pass at this point, and the location had to be fixed very minutely.

The line now follows the tortuosities of the Damuda river along its northern bank and at no great distance from it, as far as the villages of Kotar and Rulaia, near the 214th mile, where it crosses the Damuda. The ground in this section of the line is principally formed from the numerous small spurs which roll down from the higher peaks of the Sulaia range of hills. It is sidelong, cut up by very deep ravines which cross the line at right angles, and is covered with jungle. Good gradients are, however, obtained, the greater part being $\frac{1}{250}$ and $\frac{1}{1000}$. The location of this length was very tedious and difficult indeed, curves needing to be set out more than once before the required points on the ground were hit off. Along this length the cultivation is almost *nil*, and, judging from the nature of the ground, probably no considerable extension of the cultivated area is ever likely to take place.

Near this an alternative line was also located, crossing over the Damuda near mileage 209½, passing close to the village of Domaru and joining on to the main line near Rulia. It did not, however, give such favourable gradients as the line *viâ* Chainpur, and there was no saving in expense.

Not far from Koter stands the village of Santi, from whence, as before mentioned, a network of trial lines and cross sections had been run with a view to the line being taken along the north bank of the Damuda and crossing it at Dumarbera. This was a work of great labour, the country being very difficult indeed.

The crossing of the Damuda and Chatti rivers was carefully fixed at points where the banks were well defined and square with the line. There were two main features which determined the precise location of the crossing, *firstly*, the rocky hills which tail out a little to the south of Rulia had to be avoided; and *secondly*, an easy ascent from the opposite bank to the next obligatory point at Nawadih had to be found. Nawadih is situated on one of the principal spurs from the Ranchi plateau. The spur at this part shelves gradually down, and has no very abrupt features. The height to be gained was about 80 feet, and the distance somewhat limited. By taking advantage of the Koel nullah, which is shown between Rulia and Hesalong, along which ran a narrow open strip of ground, a section with very light work is obtained. The ground is hilly on both sides of this nullah.

From Nawadih the ground slopes away rapidly southward and eastward, while to the north the country is broken up by high ridges and deep valleys, which run down to the Damuda on the left. The descent to the Chatra nullah at Dukanda was over 130 feet in a distance of about three miles. This alignment was laid out so as to avoid the low hills and spurs about the locality of Bisrampur, and to turn an awkward bend in the river at the 219th mile, at the same time maintaining a continuous falling gradient, without which the valley could not have been crossed within any reasonable height.

From the 219th mile the choice lay between a line following the course of the Chatra nullah, then turning easterly along the Damuda and crossing over the next spur opposite Rai, and a line crossing the same spur at Mankitand. An inspection of the country on an elephant showed that the latter was the best route to adopt, for by taking advantage of the counter spur and the Sappei river, both of which features run parallel with the required direction, almost any level could be obtained along the base of the hill.

The Sappei river is then crossed a little to the south of the important village of Rai, the Rai-Bamni road crosses here. There is rock all across the bed at this particular point, and from the fact that the river forms a big bay immediately to the north, and on account of the sharp bend on the south, this crossing becomes an obligatory point from which the next ascent to Bachra must start.

The ascent of 64 feet to the Bachra spur was unavoidable. Beginning in the high range of hills which lie about a mile to the sout h, it runs northwards straight down to the Damuda, a distance of two miles, and could not possibly have been turned.

Between Bachra and Chapur, 10 miles, no more important ascents are made, and the line falls about 250 feet in eight miles. A good deal of jungle is met with in this length, but the ravines are not numerous. Four abrupt spurs, which run down to the Damuda, are encountered at Hosil, Mendi, Hendigir and Chapur, each of which had to be turned, necessitating a good deal of winding about. The location was a very laborious task, as often a divergence of 10 feet altered the levels some 15 to 20 feet. The cross sections were plotted daily, and every chain of the line carefully located therefrom.

The Binjaspur, at the 235th mile, terminates at the Damuda in a high rocky scarp, and is crossed at its most favourable point, and a good crossing of the next river, the Margamdaha, is also obtained.

The line now makes an ascent of about 30 feet to Tukisud, crossing a low range of hills. Advantage is taken of the nullah shown at the 236th mile to get a very smooth ascent.

The country here opens out, it is pretty clear from jungle, is cultivated, is more thickly populated, and the ground is undulating as far as the Naikari river. The line skirts the high ground of Barwadih and Sakul, leaving those villages on the right, and piercing the ridge at Patratu at its narrowest and lowest part reaches Jainagar.

After crossing the Naikari river another ridge had to be crossed near Kursa, 244th mile, and from thence there was a fall of 112 feet to the Maramgarah nullah, in a distance of about two miles. The lowest point in the ridge was first determined by a line of levels, and as there appeared to be a considerable choice of ground, several trial lines were run down to the nullah, one to the north, and the other to the south of a stream which runs almost parallel to the located line between the 244th and 245th mile. The line to the north ran over a mass of bare high rocks, and had nothing to recommend it.

The line for the next eight miles as far as Ramgarh passes through a pretty open but very undulating strip of country, between the Damuda and the lower hills of the Ranchi plateau; it is mostly cultivated; there are numerous villages studded about, and the inhabitants seem well to do; the alignment here is very direct, and there are no special features connected with it which require to be mentioned. Both high and low level lines were tried, and approval was accorded to the higher one, in order to keep well up for the rise to Ramgarh and the final junction with the east Damuda Division. Ramgarh is about 1,122 feet above mean sea level, and is 606 feet below the crossing of the Koel-Damuda watershed.

The length of the division as staked out is 57·77 miles. There were 172½ miles of trial lines run, surveyed, and levelled, up and down the valley, while 100 miles of cross sections were necessitated by the difficult nature of the country. Some 26½ miles of the most important rivers were also levelled and surveyed, and an alternative line *viâ* Domaru, 4½ miles in length, was located, making a total of 361¼ miles of work during the season.

The average height of embankment or depth of cutting is 8·65 feet. The total estimated quantity of earthwork, however, is equivalent to average section of the height of 10¼ feet. One-half the division has grades of from 1 in 100 to 1 in 150. One-tenth is on the level, and the remainder, or four-tenths, has grades varying from 1 in 200 to 1 in 1,000.

About two-thirds of the alignment is on the straight, and the remainder is set out with curves of 2,865, 3,438, 3,820, 5,730 and 11,360 feet radii, about one fourth of these being of the minimum radius.

Character of the Country.

From the zero of the division up to the Koel-Damuda watershed the country has already been described as a narrow valley surrounded by hills, forming one of the head waters of the Auranga. The line then enters the Damuda valley and traverses it as far as Ramgarh. Though, generally speaking, the Damuda river follows a pretty direct course from west to east, it winds very considerably; its tortuosities in some instances being very eccentric. For at least 30 miles, mile 205 to mile 235, the valley is very much contracted by the hills on both sides, and by the numerous lofty and rocky spurs which project from the Ranchi plateau on the south, with the Sulaia hills, and the lower hills belonging to the Hazaribagh plateau, to the north. These hills, which are exceedingly irregular in plan, broken and rugged, give the country a wild and picturesque aspect. To the right and left of the village of the road lofty peaks rise up some 1,700 to 1,800 feet above the village level. Conspicuous to the south, and rising above the valley to a height of some 1,200 or 1,300 feet is the Ranchi plateau, with its outlying spurs and hills, with their deeply furrowed and wooded slopes. These hills are never lost sight of. Nearer the located line, however, the hills are lower, as at Mahlan they rise up some 766 feet, in the locality of Patal 829 feet, the Sulaia group 200 to 400 feet, and the Mahudi block 829 feet above the valley. The ground naturally inclines towards the Damuda, being in some cases very steep and in places is freely intersected by deep ravines. In the rougher parts of the valley, in the vicinity of the line, the cultivation occurs in patches, and appears to be sufficient only for the requirements of a sparse local population: the uncultivated parts are covered with a forest of small sâl trees. However, towards the Chandwa and Ramgarh extremities of the division there is extensive cultivation, and the same may be said of the Karanpura valley lying a few miles to the north, which is a very populous part of the district and the inhabitants well to do. The principal towns are Bargaon and Tandwa.

There is no road or cart track down the valley, except for a short length, 14 miles at the Ramgarh end. The valley, however, is crossed by two very important district roads and by three good fourth class roads, all of which routes serve to connect the most important traffic centres of the Hazaribagh and Ranchi plateaux, including Palamow. They are as follows:—(1) The Lohardagga to Chattra and Palamow road crosses the proposed line near Chandwa, the descent of the plateau being made at the Bohlia pass; (2) a road crossing at Hesalong (Deonad station) *viâ* the Upa ghat; (3) the Rai-Bamni road *viâ* the Serun ghat; (4) a road crossing the line at Jainagar *viâ* the Radha-Pira ghat; (5) the Ranchi to Hazaribagh road crossing at Ramgarh.

Minerals.

This division passes through a country having a very large coal-producing area, which has hitherto never been worked. The located line taps the north Karanpura coal-field at a point four miles to the east of the Chandwa station, and runs through it for a distance of nine miles. After crossing the Damuda, the south Karanpura coal-field is entered, the line passing through its entire length of 37 miles, many parts being situated in the very heart of the coal-field. The Ramghar coal-field is also touched at Ramghar.

The following information regarding the extent of these coal-fields is obtained from Ball's Geology of India. The Karanpura coal-fields, north and south, are situated towards the head of the Damuda valley, the areas being 472 and 72 square miles respectively. The estimated total thickness of seams is 38 feet in the north and 70 feet in the south Karanpura fields. The coal is a fuel with high calorific power.

The Ramgarh coal-field has an area of 40 square miles, and is considered to be of poor quality.

The geology of the valley is described as belonging to the metamorphic, Upper Panchet Talchir, and Barakar coal series.

Two quartz pebbles were picked up near Chenpur in the hills, having marks and specks of gold on their surfaces. The natives at Santi also report the existence of gold and silver in the surrounding hills, and specimens of a yellow mica shale, which were said to contain silver, were obtained.

Red and brown hæmatite ironstone was picked up at Sonda, Dumerbera, Lupanga and between Nawadih and Chapur (six specimens), but it is found also in other parts of the division, and remains of native furnaces, long since abandoned, are numerous all over the valley. At Tandwa small quantities of iron are still manufactured.

The 15 specimens of coal are principally surface coal, picked up in the beds of rivers and nullahs in the following localities. Naikari river, Sulaichanwan, Kunkariatand, Kirigarha, Chatta river at Rulia, Hesalong, Loharsa, Bundu Huphwa, Beti, Koilra, Bhugia, Chirchuriatand, Santi, Murmur, Lohsinghna, Mahua Milan.

Four specimens of Kaolin were obtained at the Gharri river, at Bijan, and other places. The natives call it *dudh mattee,* meaning milk clay.

Borings were taken along the line, and the quality of soil met with is noted on the sections.

Waterways and sites of river crossings.

The waterways have been determined on a consideration of the areas of the different drainage basins crossed, as well as for reasons of height to formation level and nature of the crossing. The principal rivers crossed are the Gagri, 6 spans of 40 feet; the Lohsingna, 8 spans of 30 feet; the Deonad, 3 spans of 100 feet; the Chatti, 3 spans of 60 feet; the Dukanda, 6 spans of 30 feet; the Sappei, 9 spans of 40 feet; the

Hendigir, 6 spans of 20 feet; the Margamdaha, 1 span of 100 feet; the Naikari, 5 spans of 60 feet; the Murumgurha, 1 span of 80 feet; the Siarbhuki, 1 span of 80 feet; the Harharri, 1 span of 80 feet. These crossings are all on the square, and are well selected.

The Gagri and Damuda bridges would require well foundations, sunk some 15 to 20 feet below the surface of the sand, or cold weather level of the stream. Rock is found near the surface in the beds of all the other rivers and nullahs.

The minor waterways necessary average about 40 running feet per mile, or the major and minor together 77 running feet per mile.

Station sites.

The only favourable place for an engine station anywhere about midway between Sukhua and Chandil (both engine stations) is Jainagar, which is 103 miles from the former and 83 miles from the latter station.

Jainagar is the principal centre of the south Karanpura coal-field, is rather an important village, and is situated on the north bank of the Naikari river, in open cultivated country. It has a post office, and is on one of the cross roads, running between the civil stations of Ranchi and Hazaribagh, being 19 miles from the former and 23 miles from the latter. Water is obtainable from wells at no great depth, and there is a suitable valley not far off, for the construction of a reservoir, if necessary. The ridge to the north would afford excellent sites for residences.

The following is a complete list of the stations, in the order in which they occur :—

NAME OF STATION.	Mile.	Distance from last station.	Class.	REMARKS.
Chandwa	201¼	5¾	3	Water and goods.
Deonad	213	11¾	3	Passing.
Bachra	224¼	11¼	3	Water.
Jainagar	241½	17¼	2	Engine station and water.
Ramgarh	254¾	13¼	3	Water and goods.

Chandwa, the first station, is situated on the watershed, at the summit of the road incline, and close to the important district road which connects the towns of Ranchi and Lohardagga on the south with Chattra and Palamow on the north and north-west. The greater part of the export and import trade passes through this place, and it is a post-town and police outpost.

The next station, the Deonad, near the small village of Koter, takes its name from the river which is here about a quarter of a mile distant. This station is midway between Chandwa and the next station at Bachra; it is at a suitable distance for working the traffic (about 11¾ miles), and would catch the traffic entering the valley by the Upa road.

Bachra station is favourably situated for catching the cross traffic from the Ranchi and Hazaribagh plateaux, which usually passes down through the village of Rai along the Rai-Bamni road. Raie is an important village situated at a distance of about two miles from Bachra, but gradual considerations compelled the selection of the latter place for the station, the distance being 23 miles from Chandwa: watering arrangements are necessary at this mileage.

Jainagar station has already been referred to at some length as being favourably situated for an engine station.

Ramgarh station is situated on high ground nearly half a mile to the south of the town, and close to the Ranchi and Hazaribagh district road. The Gola road, leading into the fertile district of Manbhum, also branches off here. There are several large tanks in the vicinity which might be utilized for watering purposes, as they retain a good supply of water all the year round. Ramgarh is an important zemindari centre, and a periodical market is held there, which is well attended by people from all parts, within a large radius. Ramgarh is about midway between the civil stations of Ranchi and Hazaribagh, or, more exactly speaking, 24 miles from the former and 29 miles from the latter.

The stations are all favourably situated for tapping the best tracts of the Hazaribagh district and Ranchi plateau.

It will probably be found advisable to introduce a passing station at Churugarha or Chapur, midway between Bachra and Jainagar, as the traffic becomes developed.

Labour available and rates.

A limited number of carpenters and masons are always obtainable at the principal towns, as Hazaribagh, Chattra, Ramgarh, Lohardagga, Ranchi, &c., but ordinary labour is plentiful and cheap. In the Karanpura valley and surrounding country men coolies can be had for 1½ to 2 annas a day. The daily wage of a woman is 1 anna, a boy 1 anna, a plasterer 6 annas, a head mason 8 annas, a common mason 4 annas, and ordinary two bullock cart and driver gets from 6 to 8 annas a day; saggars 3 to 4 annas a day. The rate for carting is from R1 to R1-4 per 100 maunds per mile.

Materials.

No quarrying has been done in the neighbouring hills, but a variety of rocks crop up at the surface in different parts of the valley, and in the dry beds of rivers, from which it is inferred that *stone* of almost every degree of hardness is obtainable within a reasonable distance of the line. The principal rocks met with were gneiss, syenite, sandstones, conglomerates, and yellow and blue shales.

Good *clay* for bricks is obtainable at Ramgarh, Jainagar, and Chandwa. Tiles are used in all the larger villages.

Gneiss was observed at Changarha, Dumerbera, Mahlan hill, and other places, two specimens of syenite were obtained at Loharsa, and 15 specimens of sandstones were obtained from the following localities:—Pachanda, Gahrri river , Damuda river at the Mendi rapids, Chainpur, Naikari river, Gahrri river, Lohsingna nullah, and other places.

The average level for the stone *ballast* will be about 0·63 miles, and the average rate (not spread) would be under R2-12 per 100 cubic feet.

There will be no difficulty in obtaining *lime*, as will appear from the following details:—At Daredagiepat there is a deposit of limestone rock of considerable extent. This locality lies about 14 miles to the north of Chandwa. Good kunkur is found at a good many parts of the line, notably at Bhusar, Murmur (banks of Damuda), Santi (two miles off), Bundu, Kursa, Sonda, and Ramgarh, 11 specimens were obtained.

A large area of rock kunkur or massive kunkur was found in the banks and bed of the Damuda river at Dumerbera.

Coralated limestone is obtainable in large blocks in a hill at Bunda, about six miles to the west of Mondu, and is used by the Public Works Department. Similar limestone is obtainable at Lugu pahar, which is about 16 miles to the north-east of Ramgarh, and just beyond the Jugessur thana. The best specimen was obtained from the latter place, where the supply is unlimited.

Sharp, clean, *sand* is easily obtained.

There were plenty of sâl trees in the jungles passed through, of a suitable size for fencing posts or roofing poles, but *timber* large enough for sleepers and beams was not seen in any quantity. The villagers, however, report that in the vicinity of Mahudi hill and westwards a considerable number of sleepers may be obtained.

Probably the greater number of the *sleepers* required would be got from the southern slopes of the Ranchi plateau. There is a plentiful supply of jungle wood for lime burning.

Markets and traffic.

The principal trade centres of the districts passed through are Lohardagga, Chattra, and Hazaribagh; and most of the traffic passes over the road between Lohardagga and Chattra, and its branch from Chandwa to Palamow.

The imports are salt, rice, piece-goods, tobacco, spices, wheat, goor, mahowa, lac, and ghee.

The exports are oil-seeds, ghee, catechu, cocoons, lac, hides, coal and mahowa.

The exports, which are likely to be largely developed, are coal, iron ore, timber, cereals, pulses, oil-seeds, tobacco, lac, mahowa, and tea.

Lac is cultivated on the palash tree, and almost all the villages along the line.

The mahowa is also plentiful at all the villages; and as brandy has been made from it in the south of France, an increase in its export may be expected.

It is estimated that about 2,000 maunds of tea will annually finds its way to the railway at Chandwa and Ramgarh from the numerous tea gardens which are dotted about the Ranchi and Hazaribagh districts. This would be despatched to Calcutta.

There are periodical markets at Ramgarh, Umendanda, Pali, Barkagaon, Tundwa, Balumath, and Chandwa, along the line and to the north, as well as at all the most important villages on the Ranchi plateau.

Except at the Ramgarh station, the local passenger traffic will probably be very small.

Enclosure No. 9 to Railway Resolution No. 799 R. C. of 1887.

Report by Mr. J. M. **Chabrel**, Executive Engineer, on the East Damuda Division.

Alignment.

1. The zero of the division is about half a mile east of the village of Ramgarh, where the west Damuda Division ends at mileage 254, chain 50. 19, and from there the line follows the valley of the Damuda river to Ruhpura on the watershed, whence it descends to the valley of the Subanrika river, which it follows for the remainder of the distance to Chandil.

Immediately after the starting point, the line turns slightly towards the village of Kaitha to avoid the end of a spur from the main range of hills planking the Ranchi plateau; near Kaitha the line bends again to the right or south-east to cross the nullah, at chain 357 on the square, and another curve to the left takes the line on the Simra nullah at right angles. There are three small cuttings in this portion through hard earth or moorum soil. From the Simra nullah the line runs close to Chattan, a fair-sized village, crosses a nullah at chain 344,350, and making a slight bend near Barlong runs straight to Chiturpur, a large village at the 264th mile. In this length the ground undulates considerably, requiring numerous small waterways in paddy depressions and rather heavy bank and cutting. From Chiturpur the line turning south-east descends to the Kochi nullah, after passing which another slight bend takes its square across the Bhera nullah, a large stream rising in the Ranchi plateau, and thence it passes about a mile and a half south of the town of Gola, opposite 269th mile, to Ruhpura on the watershed. In this section there is heavy bank opposite Sikni, 267th mile, and again at the Bhera nullah; the remainder of the work is comparatively light.

The descent to the Subanrika valley commences a little beyond Ruhpura in the 271st mile, and involves the heaviest work in the division. There is a continuous descent of 1 in 100 for 155 chains followed by 1 in 200 for 26 chains, with a heavy cutting at the summit and a heavy bank over one and a half miles in length. This, however, is the most feasible way of crossing the watershed.

From the foot of this descent the line runs almost due east crossing the Jhuria nullah, and then turns to the right past Sondimra, 276th mile, and thence with two more curves to the Parchando hill pass, an obligatory point in the 279th mile. The Parchando spur juts out abruptly on to the left bank of the Subanrika river, and can only be rounded by crossing some low-lying flooded ground. The small pass through which the present road winds was therefore selected for the alignment. In this section the work consists almost entirely of bank, and is not heavy.

From the Parchando hill the line runs straight to Burlanga, 280th mile, and thence almost due east crossing the Dakkagarha nullah to Burjpur, mile 282, whence it follows the general curvature of the river up to Tholen on the Purulia-Ranchi road, crossing the Dhuriar, Kurial and Sanpahi nullahs on the way. In this length, especially in the latter part, the work is heavy, there being some very high bank and several large waterways. At Tholen the main road from Purulia to Ranchi crosses the line.

From Tholen the line descends to the Soldaha nullah, mile 289½, where there is not a very good crossing as the stream follows a continuous bend from its junction with the Rupai nullah to that with the Subanrika, and it was therefore not possible to get the crossing on a straight reach of the river. From this nullah the line runs straight to the 292nd mile and is nearly all in bank, but the work is not heavy. From Hariband it turns to the right and crosses a valley opposite Ilu, where there is a considerable bank, and thence crossing the ridge at Kusi descends with gradients varying from 1 in 100 to 1 in 400 to the Posti nullah, mile 297, the work being nearly all embankment and comparatively light. From this nullah the line ascends to the Phultang spur, mile 297½, which runs right out on to the Subanrika, causing the river to make a sharp bend, and cannot be rounded without excessive length of line and sharp curvature. From this ridge there is a considerable fall to the Chota nullah, mile 300, which is disposed of by a grade of 1 in 100 for 73 chains with two shorter lengths of 1 in 500 and 1 in 200. There is one heavy bank in this length, the remainder being moderate.

There is a good crossing of the Chota nullah after passing which the line near Muhtodi, mile 300¾, turns to the right and runs nearly due south past Soisa to Sumali, mile 303¼, whence there is a descent to the Karru nullah which is crossed at mile 305. Before reaching this nullah near mile 304, the line bends to the left crossing the Karru nullah on the square, and the ridge at mile 306 at the most favourable point. In this length there is heavy bank near the Karru nullah; the remainder of the work is however moderate.

From the abovementioned ridge (through which there is a long cutting) there is a sharp descent to the Sobha nullah (the gradient being 1 in 100) which, with the aid of two slight curves, is crossed nearly square, and then the line runs straight to a high ridge at

Harmuli, mile 308½, the ascent to which is all on a gradient of 1 in 100. The work in this length is heavy, there being a very high bank at and before the Sobha nullah, and another considerable bank at the latter part of the 308th mile.

There is a considerable cutting through the Harmuli ridge from which the line descends to the low ground at mile 309½, from which it runs fairly level to near Inchadih, whence there is a descent to Kenda Inda a short level, and then another short descent to the Janum nullah near mile 313. In this section there is a long rather heavy bank at the beginning and two shorter ones at Kenda Inda and the Janum nullah, the remainder of the work is light. From this nullah there is a general ascent on moderate gradients to mile 314½, there being a curve to the right about midway, and then a descent to the Sakha nullah, mile 315, which is crossed on the square. The work in this length is generally bank, which is only heavy in two places. From the Sakha nullah the line runs straight across the ridge at mile 316¾, a moderate ascent, and thence past Gopalpur descending to the Chengra nullah, mile 318¼, before which there is a sharp curve to the right, and from this point there are several curves which take the line around the end of the Sason hill near Ruvani which runs out to within a short distance of the Subanrika river. In this length the work is nearly all embankment which is not heavy excepting for a short length at the Chengra nullah. From the Sason hill the line, curving eastward, runs with short lengths of ascent and descent to the Bamni nullah, whence there is a considerable ascent to the Chandil station, where the line running almost due east joins on to the Bengal-Nagpur Railway opposite to chainage 4134·00 on that line. The principal work in this section is embankment of which there is a considerable quantity.

It will be seen from the foregoing that owing to the excessively undulatory nature of the country, the work throughout the line will be very heavy, especially in the Subanrika valley, where the ridges run sharp out on to the river bank, necessitating continually recurring ascents and descents generally on a gradient of 1 in 100. This will readily be seen from the list of gradients, where out of a total of 69·92 miles there are 27·25 miles of 1 in 100 and only 12 miles of level. The character of the country also entails heavy bridging owing to the large number of nullahs to be crossed and the numerous depressions for which outlets have to be provided.

Character of the Country.

2. As already mentioned above, the general configuration of the country is undulatory. The country in the Damuda valley in the vicinity of the line is well cultivated throughout the high lands with dry crops and the low grounds of the depressions with rice almost exclusively. The valley is, however, hemmed in by the hills of the Ranchi plateau, and there is therefore no great extent of country under cultivation. The Subanrika valley from Begedih to Badoluhur is more jungly, but beyond that the lands lying along the alignment are rich and well cultivated. This valley is also not extensive, being shut in a few miles from the river bank by jungle clad hills. The cultivation is similar to that in the Damuda valley, consisting of oil seeds, pulses, &c., on the high lands, and rice in the depressions. Throughout the route proposed there is probably only as much cultivation as is necessary for the sparse population.

Waterways.

3. The waterways do not call for any special mention. As already stated, the bridging will be very heavy, but there are no very large bridges, and owing to the nature of the country, there will probably be no difficulty about foundations.

Labour.

4. It will probably be difficult to obtain labour in large number locally. The villagers appear to be entirely of the cultivator class who did not as a rule take readily to other works, and when they do, only work during such intervals of leisure as they have from their ordinary vacations; most of the cooly labour will therefore probably have to be imported from other parts of the province. This applies with greater force to artisans, of whom there are but a few unskilful members in the district.

Materials.

5. But few indications of good building *stone* were meet with in the vicinity of the alignment, but it is probable that a more extended exploration of the neighbouring country would lead to suitable material being discovered. At Soisa there was a large quantity of fine slab-stones used as tomb-stones which would make excellent covering slabs or rough masonry. The villagers stated that they were obtained from the neighbouring hills. On the other side of the Subanrika, almost opposite to this place and also near Ilu, mill-stones are obtainable, but this stone would not stand weather well and seems to be brittle.

Kunkur *lime* can be obtained all along the line, and stone lime of good quality occurs about five miles from Chiturpur in the Ramgarh valley. Rock kunkur can also be obtained not far from Chandil. There is good *brick earth* at most places along the line, and fuel for brick burning can be obtained at a moderate rate. *Sand* for mortar can be obtained from the Subanrika and Damuda rivers or from the larger nullahs.

Good sâl *timber* can be obtained from the slopes of the hills of the Ranchi plateau. Timber is at present exported from the Sillighât in these hills. There are also large exportations from Patkum; good sleepers at a low cost can therefore be obtained.

Good *ballast* can generally be obtained, the lead will generally be about one mile.

Trade, Traffic, &c.

6. There does not appear to be much trade or traffic in the districts traversed by the line. Periodical hâts or markets are held at some of the principal villages where the inhabitants procure domestic necessaries and dispose of small quantities of local produce. These markets are, however, not far from the villages they serve, and it is unlikely that they will cause any appreciable passenger traffic until the general condition of the people improves. The imports are owing to the simple wants of the people, necessarily small, and the exports are not large, cultivation generally being practised only to an extent that suffices for local wants. Lac and timber are probably the principal articles of exports.

Enclosure No. 10 to Railway Resolution No. 799 R. C. of 1887.

Report on an alternative route from mile 275 to Purulia.

A trial line was run to the station of the Nagpur-Bengal Railway at Purulia, from the 275th mile of the main line, under instructions from the Bengal Government.

2. From the departure from main line to Purulia station is a length of 33 miles The country traversed is mostly cultivated and open, but very undulating. The estimate is based on the section taken over the trial line. By locating more to the south between Baduluku and the crossing of the Kasai river, there would be a saving in earthwork, and probably the gradients might also be eased. The waterways on this branch are very much less than on the length from Baduluku to Chandil, the largest stream being the Kasai river which would be spanned by one girder of 100 feet.

3. In paragraph 33 of report on main line it was pointed out that for goods and passenger traffic to Calcutta, this branch would be the shortest connecting link of the Benares-Cuttack Railway, northern section, with the Nagpur-Bengal Railway, although for pilgrim traffic it would involve a detour of 29 miles. The construction of this branch would attract the goods and ordinary passenger traffic of north Lohardagga and south Hazaribagh districts, and transfer it to the Nagpur-Bengal Railway.

4. The cost of the branch works amount to R1,11,817 per mile, including indirect charges, or R36,89,981 for the 33 miles. Its construction would direct most of the goods traffic of the main line from Chandil to Purulia. The goods traffic would be the exports and imports of the northern half of Lohardagga and the southern half of Hazaribagh, in addition to a fair local traffic between Ramgarh, Gola, Jhalda and Purulia.

5. In the event of construction of the southern section of the main line being set aside in favour of the alternative pilgrim route from Panchpara to Cuttack, the construction of this branch in preference to the portion of main line between Baduluku and Chandil might be advisable. For such pilgrims or travellers desiring to proceed south, the route *viâ* Midnapur and the coast road and canals would be the line of country they would adopt, and Purulia would be preferable as a terminus to Chandil, from which place there is no communication with Cuttack.

6. Owing to the smaller waterways required and the shorter length by six miles of line to be constructed, there would be a considerable economy in constructing these 33 miles in preference to the 39 miles between Baduluku and Chandil, there would be greater traffic in goods, and indirect benefit to the Nagpur-Bengal Railway.

General Abstract Estimate.

			R	R
I.—Preliminary expenses at			1,200	39,600
II.—Land at			2,000	66,000
III.—Construction—	R			
(*a.*)—Earthwork at	20,329	=	6,70,857	
(*b.*)—Bridgework at	10,163	=	3,35,379	
(*c.*)—Fencing at	2,160	=	71,280	
(*d.*)—Level crossing at	260	=	8,580	10,86,096

	R		R	R
IV.—Ballast and Permanent-way—				
(a.)—Ballast at	5,430	=	1,79,190	
(b.)—Sleepers at	10,130	=	3,34,290	
(c.)—Rails and fastenings at	13,924	=	4,58,492	
				9,71,972
V.—Stations and Buildings—				
(a.)—Station buildings at	2,012	=	66,396	
(b.)—Station machinery at	1,784	=	58,872	
(c.)—Staff quarters at	3,404	=	1,22,232	
(d.)—Workshops and stores at	1,500	=	49,500	
				2,97,000
VI.—Plant at	1,800	=	......	59,400
VII.—Rolling stock at	10,000	=	......	3,30,000
VIII.—Establishment, 10 per cent. in I to V				2,43,067
IX.—Contingencies 5 per cent. in I to VII				1,41,153
TOTAL DIRECT CHARGES				32,37,288
I.—Capitalized abatement of land revenue			655	
II.—Loss by exchange at 1*s.* 7*d.*			1,79,505	
III.—Leave and pension allowances			49,213	
IV.—Interest during construction			2,18,820	
TOTAL INDIRECT CHARGES				4,48,193
GRAND TOTAL FOR 33 MILES, AT R1,16,681 PER MILE				36,85,481

Detailed Estimate of Purulia Alternative.

LAND *vide* section V, Nagpur-Bengal, nearly R2,000 per mile.

EARTHWORK.

		R
In 62 miles from Ramgarh to Purulia, quantity = 17,22,74,020 c. ft.		
17,22,74,020 ÷ 62 = 27,78,613 c. ft. per mile.	Banks at R 6 =	16,672
1,88,94,790 ÷ 62 = 3,04,755 c. ft. ,,	Cuttings at R 12 =	3,657
	TOTAL PER MILE	20,329

33 miles, at R20,329=R6,70,857.

BRIDGE WORK.

See detail. Total cost for 33 miles=R3,35,379=R10,163 per mile.

FENCING.

See northern section, Benares and Cuttack Railway, R2,160 per mile.

LEVEL-CROSSINGS.

	R
As per Nagpur-Bengal Railway, section V	244
Distance posts, section V, at R13	13
Gradient posts	3
TOTAL PER MILE	260

SLEEPERS.

Can be delivered for R4 per each at depôt; 2,200 sleepers per mile, including stations, R8,800. 190 tons × 33 × 16 = 1,00,320 ton miles by cart at 7 annas ton mile = R43,890 cartage 43,890÷33 = 1,330 per mile for cartage.
8,800 cost of sleepers.

TOTAL . R10,130

RAILS.

		R
One mile delivered at Calcutta	R	11,280
Railway freight to Purulia, 121·78 tons, at R8-10 per ton		1,050
Terminal charges		152
Laying road		1,320
Lead to works		122
TOTAL		13,924

Number.	Description of openings.			Height above flood or bed.	Cost.	Remarks.
	No.	Span.	Flat or arched.			
		Feet.			R	
1	1	15	Arch.	30	7,500	
2	1	25	,,	34	17,000	
3	1	6	,,	24	2,000	
4	1	25	,,	36	18,000	
5	1	3	Barrel	8	436	
6	1	3	,,	12	607	
7	1	6	Arch	14	1,220	
8	1	80	Girder	36	24,000	Amrujurrah nulla.
9	1	3	Barrel	5	334	
10	1	15	Arch	26	6,300	
11	1	10	,,	23	4,050	
12	1	60	Girder	30	15,000	Dimajori nulla.
13	1	6	Arch	20	1,680	
14	1	3	Barrel	8	436	
15	1	6	Arch	13	1.145	
16	1	25	,,	26	11,300	
17	1	3	Barrel	3	339	
18	1	6	Arch	16	1,300	
19	1	6	,,	8	920	
20	1	100	Girder	38	35,000	Kasai river.
21	1	6	Arch	22	1,840	
22	3	10	,,	18	5,039	
23	1	6	,,	12	1,070	
24	1	15	,,	20	4,700	
25	1	10	,,	20	10,361	
26	1	10	,,	18	4,200	
27	1	6	,,	14	1,220	
28	1	3	Barrel	12	571	
29	1	3	,,	5	334	
30	1	6	Arch	13	1,145	
31	1	20	,,	33	12,400	
32	1	10	,,	18	3,170	
33	1	6	,,	16	1,375	
34	1	6	,,	20	1,690	
35	1	40	Girder	28	8,000	
36	1	3	Barrel	10	504	
37	1	6	Arch	22	1,840	
38	1	10	,,	20	3,535	
39	1	3	Barrel	6	368	
40	1	6	Arch	17	1,450	
41	1	10	,,	16	2,800	
42	1	6	,,	14	1,220	
43	1	6	,,	14	1,220	
44	1	20	,,	28	10,100	
45	2	20	,,	28	14,000	
46	2	20	,,	23	10,600	
47	1	3	Barrel	4	336	
48	1	15	Arch	26	6,300	
49	1	3	Barrel	5	334	
50	1	10	Arch	22	3,800	
51	1	15	,,	17	4,100	
52	1	6	,,	20	1,690	
53	1	6	,,	22	1,840	
54	1	6	,,	22	1,840	
55	1	3	Barrel	10	504	
56	1	6	Arch	18	1,530	
57	1	3	Barrel	7	402	
58	1	10	Arch	32	5,720	
59	1	25	,,	22	10,200	
60	1	10	,,	12	1,990	
61	1	15	,,	30	7,600	
62	1	3	Barrel	7	402	
63	1	10	Arch	25	4,450	
64	1	6	,,	15	1,300	
65	1	6	,,	20	1,690	
66	1	6	,,	12	1,070	
67	2	25	,,	32	21,700	
68	1	6	,,	12	1,070	
69	1	6	,,	15	1,300	
			Total .		3,35,378	

Enclosure No. 11 to Railway Resolution No. 799 R.C. of 1887.

MR. PARKER'S Report at the end of 1884-85.

* * *

Northern Section.

10. *The Northern Section* of the railway leaves the East Indian Railway at Mogul Sarai Station, which is also the junction station of the East Indian and the Oudh and Rohilkand Railways, distant six miles from Benares, which city is on the left bank of the Ganges; a bridge is now being constructed over this river by the Oudh and Rohilkand Railway Company. From Mogul Sarai to the Karamnassa river, the line traverses the Benares district of the North-West Provinces.

11. For a distance of 65 miles, the line traverses in a south-easterly direction a flat cultivated country, with a population of 270 to the square mile, but subject to inundation during the rains from the drainage pouring down from the Vindhya plateau, the base of which it gradually approaches, passing through a gap which divides the main plateau from a range of low hills east of Sasseram.

12. After crossing the Karamnassa, the line enters the Shahabad district in Bengal. Bhabua, 35th mile, is a large and important village, with a population of 5,000, and is the trade centre for produce from the Vindhya plateau. Sasseram, 62nd mile, is a town of 24,000 inhabitants, through which the Grand Trunk road passes, and is at present the terminus of a branch of the Son canals. The exports and imports aggregate 1,30,000 maunds per annum, valued at 2¾ lakhs of rupees.

13. Turning to the south-west, up the valley of the Son, and along the narrow strip of country between the foot of the Kaimur range and the Son river, the line makes for a comparatively narrow crossing of the Son at Parcha some five miles above the junction of the Son and Koel rivers. Dehri, the head of the Son canal, is about seven miles from the line at the 67th mile.

14. At Tilothu, mile 75, the produce from a large tract of flat cultivated portion of the Gya district on the right bank of the Son will probably be attracted to the line.

15. At mile 87 is the village of Akbarpur, at the foot of the Rhotas hill. The produce of the Son valley, which is now floated down the river to Nasriganj, consisting principally of bamboos and wood, will probably be intercepted here by the railway. Akbarpur is a village of some 2,000 inhabitants; communication from the west by cart with the Bengal plains ends here.

16. The Son river is crossed at the 106th mile. A bridge of 27 spans of 150 feet each on well foundations, will be required. Rock crops up in the bed, on the right bank of the river, but dips to a depth of 36 feet on the left bank, below low-water level. The abutment on the right bank will be founded at the foot of the slope of a small rocky hillock on which is the small hamlet of Srinagar.

17. After crossing the Son, the line enters the Palamau sub-division of the Lohardagga district. The country from the Son eastwards is thinly populated, hilly and undulating. The line runs up the valley of the Koel river, crossing a considerable amount of drainage from the hilly country between the Koel and Kanhan. Opposite the 128th mile is the important market of Garwa on the left bank of the Danro river, which is the trade centre for produce from the Sarguja State, and a market is held here twice a week at which lac, resin, tusser cocoons, hides, and oil-seeds are the principal articles of export. The population is about 5,000, and the town is five miles from the proposed Garwa road station. The hilly nature of the country does not admit of the line being taken nearer to the town.

18. The Koel river will be crossed at the 144th mile, a bridge of 14 spans of 100 feet on well foundations being required. At the 146th mile it is proposed to locate the Sukhua engine-station, which will also be the junction station of the Gya-Palamau Branch. Up to this point a ruling gradient of 1 in 200 is feasible. From this station to Chandil, the ruling gradient is 1 in 100. Sukhua being within the limits of the Daltonganj coal-field will be the principal coal-station on the line. Daltonganj, the head-quarters of the Palamau sub-division, five miles south of Sukhua, is a rising town of 7,400 inhabitants. A civil officer, a police and a forest officer reside here, and a court-house, school-house and charitable dispensary have been built. An increasing trade is carried on with Jashpur, Sarguja, Mirzapur, and the districts of Gya, Behar and Hazaribagh.

19. In Appendix A attached to the reconnaissance report by Captain Laugharne (*vide* enclosure No. 2 to Resolution No. 73R.C. of 29th January 1884) the present exports from Palamau sub-division are given as 4,38,380 maunds, and the imports 14,53,711 maunds. These amounts, as stated in paragraph 20 of the preliminary estimate report of the Gya-Palamau Branch, probably represent the whole trade of the sub-division, and may practically be divided between Daltonganj and Garwa.

20. Between Sukhua and Rud, 197th mile, the line traverses the Auranga coal-field, and runs within 15 miles of the Hutar coal-field, which lies to the south. A trial line was run to the village of Hutar situated on the bank of the Koel river, which shows a line of country much the same as that traversed by the main line. Should a branch be at some future time constructed, it would start from the Kodelwar station, 157th mile. The coal is said to equal the average of the Raniganj coal, but is inferior to that of Daltonganj.

21. The Auranga coal is of an inferior description, containing a large percentage of ash, but as the specimens, experimented on, both of this and the Hutar coal, were probably from the surface, it is possible that borings and further examination of the field might bring to light some better quality. Valuable deposits of iron ore and limestone, ten miles north of the line, are known to exist, the limestones being of a very fine quality, fit for building purposes, statuary, and as flux for smelting the iron. The samples of iron ore tested by Mr. Ball, the Geologist, *vide* page 459, "Economic Geology," gave from 39 to 49 per cent. of metallic iron.

22. From Rud, two alternative lines have been located. The "Plateau line," which after ascending the watershed dividing the Damuda valley from that of the Auranga, descends some 200 feet into the Deonand or Damuda valley, crossing the river, ascends the Lohardagga plateau by the Mahlan spur, and again descends at the south-east corner of the plateau to Chandil.

23. "The Valley alternative" crosses the Deonand lower down, and keeping to the low grounds at the foot of the Lohardagga plateau runs into the valley of the Subanrikha and joins the Nagpur-Bengal Railway also at Chandil. The valley of the Deonand is a trough with high hills shutting it in on either side.

24. On neither alternative can the long rising gradient of 1 in 100 from Rud to the watershed near Chandwa be avoided, but, as stated in paragraph 6 of this report, the plateau alternative, after descending 200 feet to the foot of the Mahlan incline, has an immediate ascent of 700 feet to overcome by an incline of 1 in 100, and a further rise of nearly 270 feet beyond the top of this incline to the summit level at Similia, and then descends to the level of Chandil, a fall of 1,200 feet, the incline descending from the plateau being on a grade of 1 in 100 19 miles in length.

25. The valley line, with the exception of occasional short rises and falls, necessary to pass the successive cross ridges, descends continuously to Chandil. The respective lengths of these two alternatives from Rud are 128½ and 130½ miles, the valley line being slightly the longer.

26. The cost of the line by each alternative is shown in the comparative estimates attached; the amount of waterways on each is given in Form E, and gradients in Form B.

27. The "Plateau alternative," after touching a corner of the north Karanpura coal-field, ascends the Mahlan spur, and makes for the station of Ranchi, which is the principal sudder station of Chutia Nagpur, joining on to the military station of Daranda. The description of this alignment is given in full detail in paragraphs 29 to 43 of the preliminary survey report.

28. As the whole export trade of the plateau flows to the north and to the east, from which directions also the imports come in, it follows that the same amount of goods would be carried by a railway running along the base to Chandil as by the line crossing the top. The plateau route has this disadvantage, that all through traffic must be lifted 967 feet to be dropped again 1,200 feet at Chandil. The coal required for working the 128½ miles between Rud and Chandil must be lifted in a similar manner, and if quarried in the Karanpura field must be led by carts to the station at the foot of the Mahlan incline, and by rail 37 miles to Similia engine station. Ranchi is the only important market on this alternative. The town has a population of 18,000 and a large fair is held yearly at the outlying village of Chutia.

29. The valley alternative would obtain the whole of the traffic from the plateau, and, in addition, receive that of the southern part of the Hazaribagh district. It would traverse the southern portion of the Karanpura coal-fields from end to end, passing through the middle of that portion known specially as the "South Karanpura" field, in which, moreover, would be located the engine-station of Jainagar, mile 241¼. The coal at this place is reported to be of very good quality. The pergunnah of Karanpura is said to be the "granary" of the Hazaribagh district.

30. At Chandwa, mile 201, the traffic of the western portion of the Lohardagga plateau, and the eastern portion of Sarguja, which is now led northward from the town of Lohardagga to Chatra, would be intercepted. The traffic at present amounts to 17,000 maunds of imports and 88,000 maunds of exports annually, which is carried by pack-bullocks only, and would be common to the two lines.

31. The principal stations on the valley line between Chandwa and Chandil are—*Deonath*, on the left bank of the Deonath river, which would serve the villages in the Tandawa thana, the population of which is estimated at over 70,000. *Jainagar*, an engine-station, the site of which has been selected—first, as the nearest convenient division of distance between Sukhua and Chandil; second, on account of the coal seams which crop up in the Neckari river within a quarter of a mile of the station; and third, a good site for location of quarters. *Ramgarh*, mile 254½, on the Ranchi and Hazaribagh road, nearly half way between the two sudder stations. *Gola road*, on the Ranchi and Gobindpur road, the principal market in the south-east corner of Hazaribagh, and centre of trade of the country for some miles round. Tholen, on the Ranchi and Purulia road, five miles from Jhalda, which is a well known market in Manbhum.

32. It appears doubtful, however, if the traffic either from the Hazaribagh or Lohardagga districts would be attracted to the railway, if compelled to go round by Chandil; the main line located to that station would probably carry pilgrim passengers only and a small local traffic; for trade purposes, a branch to Purulia, on the Nagpur-Bengal Railway, leaving the main line about the 275th mile, would be required.

33. A trial line in this direction was run in accordance with instructions received from the Bengal Government, which shows a section very similar to the main line to Chandil, but with less waterway, and the cost would be about R 1,11,681 per mile. A saving would be effected in distance for carriage of goods from Hazaribagh and Lohardagga districts to Calcutta, of 39 miles; the distance from mile 275 of main line to Purulia being 32 miles, but to Chandil and back to Purulia the distance would be 71 miles.

Enclosure No. 12 to Railway Resolution No. 799 R. C. of 1887.

* * * * * * * *

No. 516, dated Cuttack, the 14th April 1883.

From—A. Smith, Esq., Commissioner of the Orissa Division,

To—The Secretary to the Government of Bengal, Public Works Department.

* * * * * * * *

2. Of the many benefits that the province will derive from being connected with the other parts of India by a system of railways there can be but one opinion, and the only question for consideration is the financial prospects of such a scheme.

* * * * * * * *

13. From whatever point of the Barakur and Nagpur line the branch railway to Cuttack starts, it is certain that, both from a political and economical point of view, the gain to the country would be enormous; that the line will pay there cannot be the slightest doubt; it will attract an immense number of pilgrims from Bengal and Upper and Central India; it will monopolise a large portion of the trade that is now being carried on with great difficulty and enormous cost by land and water; trade and commerce will spring up where it is not now thought of; and a vast extent of country now lying unoccupied and useless for all practical purposes will be utilised.

* * * * * * * *

15. Statistics of trade carried on over one of the principal roads along the course of the Mahanaddi are now being collected in accordance with the instructions contained in paragraph 5 of your No. 898R of the 6th March 1882.

16. These statistics are being collected at Cuttack and at Barmul in Daspala on the line of road that runs from Cuttack to Sambulpur through Sonpur and also on the river Mahanaddi. Two statements, marked A and B, are annexed, showing the figures for the past eight months, from July 1882 to February 1883. This, it must,

however, be remembered, is only a portion—a very small portion—of the traffic that will without doubt, be carried by a line of railway taking this direction. It will monopolise nearly the whole of the trade that now passes through this line; it will take up at least three-fourths of the trade that is now being carried on chiefly by means of pack-bullocks along the road to Sambalpur from Cuttack *viâ* Angul. It will accommodate a large portion of the pilgrims that now come in immense numbers by different routes from all parts of India, and will also take up a portion of the trade between Cuttack and Northern India. It will take up, up to a certain distance, the trade that comes from the Madras Presidency to Cuttack, Sonpur, and Sambulpur, and will also have an immense amount of local trade. This it will have at starting, and the greater influx of pilgrims that will certainly come on account of the facilities afforded by railway communication, and the stimulus that the trade of the country will receive, should not be lost sight of.

17. Orissa, on account of its isolated position, is liable to famine. It has a system of canals which gives protection to a portion of the Cuttack and Balasor districts, but a large portion of the province lies beyond its influence, and can be protected only if, in addition to the canals, a railway is provided, and it is connected with the other parts of India by land as well as by water.

* * * * * * *

19. There is another and also a very potent reason why the system of railways should be extended to Orissa. Owing to the immense number of pilgrims that at all times and seasons of the year, and specially during the rains, when the Rath festival comes on, crowd to Puri, it has specially become the home of cholera, and the suffering and loss of human life that it causes in each and every part of India is great. Weary, emaciated, under-fed and under-clothed pilgrims who continually pass to and fro in sunshine and rain, carry the disease along with them in every direction; and although the sanitary arrangements that have in recent years been made have partly reduced the death-rate, still the loss of life is terrible to contemplate. There is no doubt that the pilgrims become amenable to the influences of the disease from the long and tiresome journeys without good food and proper shelter, and nothing will afford such efficacious relief to Orissa—nay India—from this scourge as the construction of a railway.

* * * * * * *

53. We have no statistics to show the traffic that comes from the different directions which the railway will catch at Khurda; but looking into the figures of the statement of traffic coming from one direction and collected at Mardah, a copy of which was forwarded with my No. 975 of the 3rd July last, it appears that between the months of March 1880 and February 1881 the traffic was as follows, *viz.*:—

Passengers	86,284
Pack-bullocks	5,084
Loaded carts	6,928

54. The statistics collected at Tangi show that during the nine months from December 1878 to August 1879, 32,126 loaded carts, 7,997 laden bullocks, and 33,145 foot passengers came from Ganjam to Khurda and *vice versâ*, and adding one-third for the remaining three months, we find that for a whole year the figures come to—

Foot passengers	44,183
Laden carts	42,833
„ bullocks	10,663

55. Having these figures in view, we may safely calculate that by making a detour through Khurda we will at the outset increase the railway traffic by 60,000 passengers, 30,000 carts and 5,000 bullocks, and then if we reduce the rate for through passengers in consideration of the greater distance to 2 pies, and of the goods traffic to ½ pie per maund, we will arrive at the following figures:—

Khurda Route.

Coaching	Through passengers	$4,51,000 \times 2 \times 60 \times \frac{7}{8} \div 192$	$=$ 2,46,640
	Khurda ditto	$60,000 \times 2 \times 30 \times \frac{7}{8} \div 192$	$=$ 16,406
	Local ditto	$60 \times 10 \times 52$	$=$ 31,200
Goods	As per direct route	$9,53,000 \times 30 \times \frac{8}{4} \times \frac{1}{2} \div 192$	$=$ 55,839
	Additional for Khurda	$30,000 \times 10 = 3,00,000$ $5,000 \times 3 = 15,000$	
		$\dfrac{3,15,000 \times 30 \times \frac{1}{2}}{192}$	$=$ 24,609
Ferry and miscellaneous			$=$ 40,000
		TOTAL	4,14,694

56. The above figures give a total gross income of ₨4,14,694, and deducting 60 per cent. on account of working expenses, the net profit stands at ₨1,65,878, which means an income of over 4 per cent. on a capital of 40 lakhs.

Enclosure No. 13 to Railway Resolution No. 799 R.C. of 1887.

No. 22R.T.—R., dated Dacca, the 29th August 1883.

From—The Secretary to the Govt. of Bengal, Public Works Dept., Railway,

To—The Secretary to the Govt. of India, Public Works Department.

I AM directed to acknowledge the receipt of your letter No. 732R.C. of the 18th instant, and, in reply to the second paragraph, to state that His Honour the Lieutenant-Governor, having no personal knowledge of the tract of country which a railway from Lainghar or other suitable point on the Nagpur and Barakur line would serve, has to rely to a great extent upon opinions recorded by the Commissioner of Orissa and other local officers on the subject.

2. The line of country referred to is, for want of good communications, generally perhaps the least known in this province; and though since the Orissa famine of 1867-68, communications with Cuttack and Orissa generally have been largely developed by sea, and the canals made and still under construction, these advantages only extend to the sea-coast towns and their neighbourhood, and do not in any way affect the hill tracts in the interior.

3. The Commissioner has remarked that Orissa, from its isolated position, is liable to famines, and its system of canals by itself affords no adequate protection to the province generally against the calamities of drought and scarcity; and having regard to the configuration of the country, and the vast area which stretches north-westwards into the interior from Cuttack, now almost entirely without good communications, the Lieutenant-Governor quite concurs in what the Commissioner reports in the 13th paragraph of his letter No. 516 of the 14th April last, copy of which was forwarded to the Government of India, with this office letter No. 3072R. of the 6th instant, and which is here quoted:—"From whatever point of the Barakur and Nagpur line the branch railway to Cuttack starts, it is certain that, both from a political and economical point of view, the gain to the country would be enormous; that the line will pay there cannot be the slightest doubt; it will attract an immense number of pilgrims from Bengal and Upper and Central India; it will monopolise a large portion of the trade that is now being carried on with great difficulty and enormous cost by land and water; trade and commerce will spring up where it is not now thought of; and a vast extent of country now lying unoccupied and useless for all practical purposes will be utilised."

4. I am to observe that what Mr. Smith thus says regarding the great difficulty and enormous cost of conducting the trade is confirmed by the statement recorded later on in the 17th paragraph of his letter, that that trade is now being carried on chiefly by means of pack-bullocks along the road from Cuttack *viâ* Angul.

5. Further statistics of existing traffic are being collected, and will be submitted as soon as received; but whatever it may be, a railway in these parts will not only rapidly develop it, but will be the only means of giving security in times of famine to a wide area of country extending some thousands of square miles.

Enclosure No. 14 to Railway Resolution No. 799 R.C. of 1887.

Copy of a letter No. 13C., dated 31st December 1884, from the Secretary to the Chief Commissioner, Central Provinces, P. W. Dept., to the Secretary to the Government of India, P. W. Dept.

I AM now directed to reply as follows to your memorandum No. 01R.C., dated 19th November last, forwarding, for the opinion of the Chief Commissioner, certain correspondence connected with the proposed Benares-Puri Railway, and enquiring how far a route which would to some extent serve the Sambalpur district might be practicable from Laingarh or some station further west which would not entail too long a detour on the pilgrim traffic from the north-east.

It was deemed desirable to obtain this opinion on the reference of Colonel Bowie, Inspector-General of Prisons and Police, who is intimately acquainted with the Sambalpur district; and I am desired to submit, for the information of the Government of India, a copy of his letter No. 7230, dated 10th current.

The Chief Commissioner's opinion (in which he is supported by that of Colonel Browne, Secretary, Public Works Department) is that Colonel Bowie's advice is sound. The distance of the proposed line through or near Sambalpur will be under 200 miles, differing little from that of the line through the Keunjhar plateau. There will, however, be no large bridges to construct, and the heavy work of crossing the Brahmini river will be avoided. The objection to this proposal is that pilgrims from the east will have about 100 miles more of the Nagpur-Bengal line to traverse than they would if the Cuttack line took off from Kuchai and about 50 miles more than if the point of leaving the Bengal line was at Laingarh. The pilgrims from the west will, however, be the gainers to the same extent, and therefore it seems open to the Government to adopt the cheapest and easiest route. The pilgrim traffic will not be appreciably affected, whichever route is chosen.

The Chief Commissioner records this as his opinion, having regard to the general interests of the country, and not with any desire of benefiting the Sambalpur district in particular.

Copy of a letter No. 7230, dated the 10th December 1884, from LIEUT.-COL. M. M. BOWIE, Inspector-General of Police, to the Secretary to the Chief Commissioner, P. W. Dept.

I HAVE the honour, in acknowledging the receipt of your No. 7890, dated the 8th instant, with its annexure, to state that, in my opinion, the Sambalpur district would not be in any way served by a line running from Laingarh to Cuttack. If such a line were taken along the valley of the Brahmini river, the only part of the Sambalpur district through which it would pass would be the Bamra State. From Laingarh to Talcher also the line would pass through a waste of hill and jungle, and if a practicable route could be found, which I am almost certain would not be the case, the construction of a railway along it would be certain to prove very expensive. I have myself travelled through the greater part of the Bamra hills, and I should say that a line from Laingarh to Cuttack would prove just as difficult as a line across the Keunjhar plateau to Cuttack.

2. I think then that the line should start from a point considerably further west; and as the Sambalpur district would be best served by a line which ran in the neighbourhood of the town of Sambalpur, I think the nearest point to Sambalpur on the east of the Ib river should be the point selected. As the papers regarding the Nagpur and Sitarampur Railway are not at present in your office, I have been unable to learn what is the name of the station for Sambalpur on this main line; but I believe it is Panchpara, a village close to the point where the line crosses the Ib at Rajpur. Assuming this to be the name of the station, I would strongly recommend that the line should run from Panchpara to Sambalpur, and from Sambalpur along the old Rampur and Angul road to Cuttack. This is the shortest and I believe the best route that could be taken. If the starting point of the line were made at a point midway between Panchpara and Laingarh, it would still be necessary to skirt the hills which lie within 20 miles of Sambalpur, so that the distance which pilgrims from the east and north would have to travel would be very little decreased, while the length of the line, and consequently the cost of construction, would be very greatly increased.

3. From Panchpara to Sambalpur the line would run through a well cultivated and thickly populated tract of country, and from Sambalpur through Rampur and Angul to Cuttack it would run along the watershed between the Brahmini and Mahanaddi rivers; and though a great part of this route, as far as Angul, is through jungle, there is much land capable of cultivation, and the sâl forests of Radhakol are perhaps the finest in India. I can say confidently also that no serious engineering difficulties exist along the whole of this line. The country between Panchpara and Sambalpur is thoroughly well known to me, and I have frequently travelled along the Sambalpur and Rampur road to Angul and Cuttack.

From Panchpara to Sambalpur the country is open and undulating, and only a few large nullahs running into the Ib have to be crossed. On the section between Sambalpur and Cuttack some hill ranges have to be crossed; but these are low, and there is no difficult Ghât on the road; there are also very few rivers or nullahs of any size. In fact I do not think that anywhere along the whole line it would be found necessary to construct a bridge as large as that over the Wainguna.

4. If it be considered compulsory to take the line *through* the Talcher coal-fields, it would be necessary to take a line to the north of that I have here indicated, and it will be seen that there is another road marked in the map running through the villages of Megpal and Hiraloi, which also goes to Angul. I am not so well acquainted with this route, having only travelled along it a short distance into the Radhakol State; but I believe that it also does not present any serious difficulties. It is not, however, I believe, so direct as the road through Rampur to Angul; and as this last-named route also must pass close to coal-fields, there would be no great difficulty in constructing a branch to Talcher if workable coal were ever found there in sufficient quantity.

5. My opinion then is that the line which ought now to be surveyed is that above detailed, *viz.*, from Panchpara to Sambalpur and from Sambalpur to Cuttack *viâ* Angul. I am quite certain that an attempt to get a practicable line from Laingarh to Cuttack would fail, and any intermediate line would prove more expensive in construction and would have no compensatory advantages that I can see.

No. 319, dated the 10th January 1885.

Memo. by the Offg. Secretary to the Chief Commr., Central Provinces, P. W. D.

COPY of the following is forwarded to the Secretary to Government of India, Public Works Department, for information, in continuation of Central Provinces Public Works letter No. 13C., dated 31st ultimo.

Copy of a letter No. 110C.—A., dated 16th December 1884, from the Director of Agriculture, C.P., to the Secretary to Chief Commissioner, C. P., P. W. D.

IN reply to your letter No. 7889 of the 8th instant, I have the honour to state that I have no personal knowledge of the greater portion of the tract through which it seems that the proposed line would pass, and am therefore quite unable on so short a notice to offer an opinion which would be in the least worth having. The line which the proposed railway would take is not quite clear from the papers annexed to your letter; but I presume that the alternative route now referred to would carry the Puri Railway down the valley of the Ib, and that the railway would therefore pass in the close vicinity of Sambalpur instead of running some distance east of it, as would be the case were it carried over the Keunjhar plateau on the eastern border of the Bamra State. A railway running to Sambalpur, down the valley of the Ib, would pass through a tract which I know to be of considerable fertility, and so far as provincial interests are concerned, would be of course out of all comparison more advantageous than a line which would merely touch the Sambalpur district on the eastern border of the Bamra State, which is, I believe, a tract of little present fertility.

Copy of a letter No. 373, dated 13th January 1885, from the Secretary to Chief Commissioner, C. P., P.W.D., to the Secretary to the Government of India, P. W. D.

IN continuation of Central Provinces letter No. 13C., dated 31st ultimo, and enclosure, having reference to the proposed Benares-Puri Railway, I am now desired to forward a copy of a letter No. 7372, dated 18th idem, and enclosure, from the Commissioner, Chhattisgarh Division, connected with the subject.

Copy of a letter No. 7372, dated Camp Desgaon, 18th December 1884, from Commissioner, Chhattisgarh Division, to the Secretary to the Chief Commissioner, C. P., P. W. D.

IN reply to your No. 7888, dated 8th instant, I have the honour to forward the accompanying letter from Deputy Commissioner, Sambalpur, dated 17th instant, advocating Talpachia as the point to which the junction of the Benares-Puri line with the Nagpur-Bengal Railway should be brought in order to serve to some extent the requirements of the Sambalpur district. I agree with the Deputy Commissioner that, in the interests of the Sambalpur district, Telpachia would be a better point for the junction than Laingarh or Sagra. At the same time if the line is brought either to Laingarh or Sagra, it will draw a considerable portion of the trade and pilgrim traffic of the Sambalpur district; but the further west and south the line can be brought consistent with other conditions, the better it will serve the wants of the district.

Enclosure No. 15 to Railway Resolution No. 799 R.C. of 1887.

MAHANADDI-VALLEY RAILWAY FROM PANCHPARA STATION OF THE BENGAL-NAGPUR RAILWAY, *viâ* SAMBALPUR, TO CUTTACK.

Note by MR. W. H. PARKER, Engineer-in-Chief, Benares-Cuttack Railway Survey, and Offg. Joint-Secretary to the Government of Bengal, Public Works Department.

This line has been suggested as an alternative pilgrim route, in place of the section of the Benares-Cuttack Railway, from Kantera to Cuttack, of which a survey was made in 1884-85, and which ran through the Keunjhar State, a line affording no immediate prospects of any traffic beyond that of pilgrim passengers from Benares and Gya to Puri.

2. That section of railway, with additions made by the Secretary to the Government of Bengal, Public Works Department, was estimated to cost R2,41,90,000 for 182 miles of line, terminating on the left bank of the Mahanaddi. To connect it with the Cuttack-Puri section, *viâ* Khurda, would add ten miles to the length and R17,00,000 to the cost, making a total of R2,58,39,000, of which amount R49,00,000 was due to the bridges required over the Brahmini and Mahanaddi rivers.

3. The estimate of the alternative route now proposed up to the left bank of the Mahanaddi, after correction and addition of "Indirect charges," amounts to R1,95,30,651, and adding R25,00,000 for the cost of the Mahanaddi bridge and 3½ miles connection with the Cuttack-Khurda-Puri line, the total would be R2,20,30,651 or R38,08,349 less than the Kantera-Cuttack route.

4. This line would not accommodate the pilgrims from Northern India and Lower Bengal; but quite as many persons, if not more, visit Puri from Western India, who would not have travelled over the Kantera-Cuttack route. It has the advantage of running through the Talchir coal-field, would tap the valleys of the Brahmini and Mahanaddi, many parts of which are very fertile, and would carry the trade of Sambalpur, a town of 12,000 inhabitants, which is now conveyed between Cuttack and Sambalpur by boats and pack-bullocks. The navigation of the Mahanaddi is so difficult that the pack-bullocks compete successfully with the boats. There is little fear, therefore, of the river competing with the railway for traffic.

5. Captain Laugharne, in paragraphs 9 and 10 of his note, details the further advantages of this line over the Keunjhar route, *viz.*, the reduced cost of working, due to more favourable gradients, the proximity of the Talchir coal-field, and the shorter distance grain would have to be carried, to supply the famine-stricken districts of Orissa in times of scarcity.

6. The alignment suggested by Mr. Von Ahn *viâ* Denkanal and Hero to Panchpara, leaving Sambalpur ten miles to the west, appears to be the best. It might be advisable to take the line closer into Sambalpur, which would add five miles to the length. Although the trade of Sambalpur itself is not very great, the proximity of the line to the town would soon increase it, and the necessity of a branch at a future date would be avoided.

7. In the note by the Chief Commissioner, Central Provinces, on Mr. Fuller's report, No. 240 of 11th July 1883 (paragraph 5), he states that the crossing of the Mahanaddi at Sambalpur is very difficult, and that the traffic from the south of the river is all carried by boat, and will probably continue to be so carried, as the tributaries on the south are all more or less navigable.

8. The railway traffic at first would, perhaps, be confined principally to the district north of the Mahanaddi, the trade of which at present is but small, owing to the difficulties of carriage; but the cheapness, and greater speed in transit, afforded by the railway, would probably soon attract the traffic also from the southern districts.

9. From a statement of statistics collected at Burmul on the right bank of the Mahanaddi and of traffic on the Mahanaddi from July 1882 to July 1883, the most important articles of export and import amount to 2,118,180 maunds exports, 780,739 imports, and 103,932 passengers up and down.

10. Mr. Smith, Commissioner of Cuttack, in 1883, reports, in his No. 516 of 14th April 1883, that, from whatever point of the Nagpur-Bengal Railway the branch railway to Cuttack may start, the gain to Orissa would be enormous, that such a line would attract an immense number of pilgrims, would monopolise a large portion of the trade now carried on by land and water, that trade would spring up where now it is not thought of, and that large tracts of country now lying unoccupied would be utilised.

11. Mr. Gupta, Officiating Collector of Puri, in his No 1363 of 22nd December 1883, reports to the Commissioner of Orissa that the average number of pilgrims visiting the shrine at Puri for nine years from 1874 to 1882 was 210,605, the largest number in any one year being 337,235, and this estimate taken from police reports he considers on the safe side.

12. Taking half the existing traffic reported in paragraph 9, and adding for pilgrims and the extra traffic in wood, fuel, coal, and timber that would immediately be created, a moderate estimate of the gross receipts per annum would be as follows; taking passenger fares at 3 pie per mile, and goods at ½ pie per maund per mile:—

	R
300,000 passengers at R2-13 for 180 miles	8,43,750
14,49,460 maunds goods, at As. 7-6 for 180 miles	6,79,434
Local and miscellaneous traffic, at R20 per mile per week . .	1,87,200
GROSS ANNUAL RECEIPTS . .	17,10,384

13. This return would amount to 7·76 per cent. on R2,20,30,651, the cost of the line including the Mahanaddi bridge, and 8·74 per cent. if the bridge and connection with the Cuttack-Puri line be omitted. As coal is procurable within a short distance of Panchpara, the western end of the line, and in the Talchir district at the eastern end, working expenses would be under the average of Indian lines, and 50 per cent. of the gross receipts a fair

allowance, leaving a profit of 3·88 per cent. for a line crossing the Mahanaddi, or 4·37 per cent. for a line terminating at Naraj.

14. The construction of this line would add to the traffic on the Cuttack-Puri line by the additional number of pilgrims visiting Puri from Central India, which may be taken at least as 200,000 per annum up and down. At the rate of 3 pie per mile, for 50 miles, a passenger traffic would be added to the Puri line of R1,56,250, or R60 per mile per week. In addition to this may be added the extra receipts that would be taken by the Nagpur-Bengal Railway between Nagpur and Panchpara.

15. Since the return of the Panchpara-Cuttack reconnaissance party to head-quarters, a letter* has been received from the Commissioner of the Orissa Division, suggesting, as a better route between Orissa and the Central Provinces, a line from Khurda on the Cuttack-Puri proposed railway to "a point between Sambalpur and Raipur on the bank of the Raipur-Mahanaddi." The object of this line would be to connect the Central Provinces more directly with Puri, as a seaport outlet for the trade between the Central Provinces and Madras, and to save the cost of bridging the Mahanaddi at Naraj.

* No. 659, dated 6th June, to the Secretary to the Government of Bengal, Public Works Department.

16. The Commissioner's proposal is based on information from native sources to the effect that the country is fairly open, presenting no great natural difficulties, and he does not apparently contemplate a junction with the Nagpur-Bengal Railway; but it is presumed that it would be necessary to cross the Mahanaddi near Raipur to effect this junction. The Indian Atlas maps do not confirm this native report of fairly open country to the west of Khurda, through which a railway might be economically constructed. The country appears to be a mass of hills, and the rough tracing of the proposed routes shows by its sharp bends and twists that natural difficulties do exist.

17. A suggestion somewhat similar to this was made by Mr. Smith, Commissioner of Orissa, in 1883, in his No. 516 of 24th April, for an alternative line up the right bank of the Mahanaddi; but in paragraph 14 he acknowledges that heavy banks would be required to keep above floods and tunnelling through the hill ranges.

18. Part of the route suggested by Mr. Metcalfe would be on the alignment of the Raipur-Vizianagram project, which has been rejected, and the construction of a line in this direction would, judging from the heights shown of the different ranges of hills, and the magnitude of two tributaries of the Mahanaddi, which have to be crossed, prove very expensive, and involve the construction of some 70 or 80 miles of extra railway.

19. The advantage of the coal-fields of Talchir and Hengir would be lost to the line and working expenses be increased by the cost of coal. The construction of the Mahanaddi bridge at Naraj, would not be an undertaking of such difficulty as is represented by the Commissioner, and might be completed in four years at the outside.

20. The town of Cuttack is unapproachable on any side by a railway, except at great expense, the Mahanaddi, on the north side of the town, being a mile-and-a half wide, the Katjori, on the south side, being as wide as the Mahanaddi at Naraj. A station on the south bank of the Katjori would be easier to get at from Cuttack town than one on the north bank of the Mahanaddi. A branch of six miles would connect the Katjori station with the through line from Panchpara to Puri.

21. Considering the extra length of construction required to connect Raipur directly with Puri, also the topographical features of the country shown on the map, and the disadvantage of leaving out the Talchir coal-field, this route does not appear one that can be recommended as a substitute for the line from Panchpara to Naraj.

Enclosure No. 16 to Railway Resolution No. 799 R. C. of 1887.

Note by Mr. J. B. Fuller, on the extension of Railway Communication to the Sambalpur District, dated August 1886.

The object of this note is to discuss the advantages which would result from the extension of railway communication to the Sambalpur district. The facts on which the consideration of this question is based, so far as they are not supported by statistics, are derived from my personal acquaintance with the Sambalpur district, in which I have spent a portion of two camping seasons, and from information which has been contributed by Mr. Goodridge, the present Deputy Commissioner of the district.

2. The Sambalpur district forms an oasis of highly cultivated land in the midst of an extensive region of hills and forests. Towards the west it is separated from the Chhattisgarh plain by 75 miles of almost continuous jungle. On the south it is bordered by the feudatory chiefships of Patna, Sonpur, and Kalahandi, which cover a tract of wild country extending almost as far south as the Godavari. On the east a wide belt of hills and forest separates it from the plains of Orissa, and, extending round towards the north, merges into the wild country of Chota Nagpur. The only approach to the district which does not lie through thick jungle is by the left bank of the Mahanaddi, along which there lies a narrow strip of cultivated country forming the Padampur-Chandarpur zemindari and part of the feudatory State of Raigarh. The lie of the district compared with the country

which adjoins it will be seen from the annexed map, in which the open country is coloured yellow, and hills and forests green.

3. The open portion of the Sambalpur district covers about 2,468 square miles, of which 1,892 square miles are held direct from Government by the villagers and 576 square miles belong to the zemindaries of Padampur-Chandarpur, Kodibaga, and eight other petty zemindaries towards the south. Isolated though it is, this tract is one of the best cultivated and most thickly populated in the Provinces. The population of the part of Sambalpur held direct from Government falls at the rate of 191 to the square mile, a rate which is exceeded in only two districts out of the eighteen which comprise these Provinces. The population of the Nagpur district falls at the rate of 200 to the square mile, but this is in great part due to the large urban population of the towns of Nagpur and Kampti. The population of Bilaspur falls at the rate of 203 to the square mile. Hence in regard to density of population the Sambalpur district ranks third in the Provinces. As might then be expected, the proportion of the total area which has come under the plough in Sambalpur is higher than in most other districts. Exact figures will not be forthcoming till the conclusion of the present settlement survey, but the statistics which have been collected up to date indicate that between 60 and 70 per cent. of the total area is under cultivation, whereas in only one other district (Wardha) does the percentage of cultivated to total area exceed 50. Next after Wardha come Narsinghpur (49 per cent.), Raipur (49 per cent.), Nagpur (48 per cent.), and Bilaspur (46 per cent.). Hence the Sambalpur district may be regarded as exceptionally well cultivated. Of the total "open" area of 2,468 square miles, 1,600 square miles may be regarded as under cultivation.

4. Not only is the proportion of cultivated to total area exceptionally high in Sambalpur, but the cultivation is of exceptionally good character. Rice covers nearly three-fourths of the area under the plough. The produce of this crop depends very greatly indeed on the method of its cultivation. If grown from transplanted seedling, its yield is very much larger than if grown from seed sown broadcast. In the districts of Raipur and Bilaspur the rice crop is almost entirely grown from broadcasted seed, but in Sambalpur a very large proportion is grown from transplanted seedlings, and this is a very striking difference between the agricultural system of Sambalpur and that of the other tracts included in the Chhattisgarh Division. The Sambalpur district is also noted for the production of sugar, and the sugarcane plays a very important part in its agriculture. For its successful cultivation a fine loam is absolutely necessary, and this occurs abundantly in Sambalpur, but is comparatively rarely met with over the rest of the Provinces, or indeed anywhere in the Deccan, where the prevailing soils are black soil or soils into the composition of which black soil largely enters. The area under sugarcane in Sambalpur cannot be stated even approximately, but it is considerable, and sugar is exported in considerable quantities eastward towards Cuttack and westward towards Nagpur. It is a striking indication of the low cost at which sugarcane can be grown in Sambalpur that it is found possible to cart the produce 350 miles to the Nagpur market. There is also a considerable export trade in the til oilseed (or gingelly), which is produced in large quantities in the poorer soils, and last cold weather I met 80 carts belonging to a single village returning to Raipur laden with til seed.

5. So far as production is concerned, the Sambalpur district is then exceptionally well off, and it might be expected to pay a relatively rather larger revenue to Government than the other districts of these Provinces. But its contribution is almost ludicrously small. The present land revenue of the tract held direct from Government is, including assignments, only R1,15,600, which falls at the rate of 1·5 anna per acre of total area and 2·3 annas per acre of cultivation. I contrast below the land revenue incidences in some other typical districts :—

	INCIDENCE OF LAND REVENUE.	
	Per acre of total area.	Per acre of cultivated area.
Raipur	2·1	4·2
Bilaspur	1·6	3·5
Bhandara	3·3	9·2
Wardha	5·2	8·7
Narsinghpur	5·4	11·0

The re-settlement now in progress may be expected to result in a very considerable increase of revenue, but when this is included, the incidence of the land revenue per acre will still be strikingly small. The reason of this lies in the great difficulty which the people have in exchanging their produce for cash. There is a distance beyond which raw produce cannot be carried with profit, though its cost of production be extraordinarily low, and the distance which separates Sambalpur from markets is exceedingly near this limit. Rice—the staple product—will not bear the cost of transport to Raipur, and though sugar and til seed can be transported with some profit, yet the profit is small and uncertain. The main export route is the river Mahanaddi, down which a considerable amount of rice is annually exported in boats to Cuttack. But unfortunately the navigation of the Mahanaddi is exceptionally difficult below Sambalpur owing to rocks and rapids, and only boats of small size can be employed. As a rule, a boat carries no more than 175 maunds. The boatmen can only navigate by day, and have to cast anchor at night: even with this precaution wrecks are not uncommon; and the channel is only open for four months in the year. Moreover, the market to which Mahanaddi leads—Cuttack—is one in which rice is exceptionally cheap. The tract in which the rice of Sambalpur would be in demand lies on the western side of the Peninsula. But its only communication is with the eastern coast, where rice is at times almost a drug in the market.

6. The line which a railway to Sambalpur should follow, if it was aligned along the most open route, would be from the Bilaspur district following the course of the Mahanaddi, and keeping as near to the river as engineering considerations permitted. The alignment of the proposed railway between Bilaspur and Calcutta lies considerably to the north of the cultivated tract on the left bank of the Mahanaddi, but provided that it is brought into connection with the town of Sambalpur by a branch from Panchpara, it should serve the requirements of the district tolerably well. But the construction of this branch is of the highest importance if the line is to derive much traffic from the Sambalpur district, or is to benefit the Sambalpur district to the extent which should be expected of it. Panchpara lies at the extreme north-east corner of the plain, 45 miles distant from Sambalpur, and 70 miles distant from the fertile tract which lies round Bargarh to the west of Sambalpur. The construction of a branch to Sambalpur should form part of the project for the Bilaspur-Calcutta line, whether it is intended to carry it on to Cuttack or not.

7. A branch line to Sambalpur in addition to attracting the traffic of the district might be expected to gain something by intercepting a considerable traffic which now runs down the Mahanaddi past Sambalpur. "The proposed line of railway from Nagpur to Calcutta," writes Mr. Goodridge, "will not touch the main arteries of the water system of the Chhattisgarh country at suitable points, will not in fact touch the Mahanaddi at any point. It will cross its tributaries, the Sheonath at Drug, and again on the borders of the Raipur and Bilaspur district at Nandghât, and the Arpa and Hassod in the Bilaspur district. But at none of these places is there likely to be any great boat traffic. By bringing the line to Sambalpur, Cuttack and the Eastern Coast will be placed in communication by water with every portion of the Chhattisgarh country from Pendra in the north of the Bilaspur district to Khariar and Kanker in the south, and from Khairagarh and Kawardha in the west to the eastern portions of the Sambalpur district. It will be noticed that all of the rivers that water the Chhattisgarh country converge towards Sheorinarain, and also that between that town and Sambalpur several large rivers from the north fall into the Mahanaddi before it reaches Sambalpur. During the rainy season, therefore, the whole of the productive Chhattisgarh country, and a portion of the Chota Nagpur Garjat States, are in easy water communication with Sambalpur, and would be with Cuttack also but for the rocky beds and rapids below Sambalpur. If the railway does not touch the river at some point between Sheorinarain in the Bilaspur district and Sambalpur in this district, it will never, in my opinion, be able to work in communication with the boat traffic of this district and the Chhattisgarh country. The most convenient point in the Mahanaddi for the railway to tap the water-borne trade is Sambalpur."

8. It will be inferred from what has been written above that the present export trade of Sambalpur cannot be accepted as an indication of what the export trade would be were Sambalpur given the benefit of railway communication with the places where its produce is most in demand. The routes along which the present trade of the Sambalpur district run are—

(1) to Cuttack down the Mahanaddi,
(2) to Cuttack by road *viâ* Angol,
(3) to Raipur by road.

We possess statistics of only the first stream of traffic, which has been registered since April 1884, at a registration post established on the river at Binka. The returns of each of the two subsequent years are abstracted below :—

YEAR.	Rice.	Sugar.	Metals.	Salt.	Cocoanut.	All other commodities.	TOTAL.
	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.
			Down stream to Cuttack.				
1884-85	1,24,297	614	...	...	...	20,678	1,45,589
1885-86	1,28,493	244	...	...	...	18,299	1,47,036
			Up stream from Cuttack.				
1884-85	...	...	2,813	53,345	13,130	5,799	75,087
1885-86	...	...	3,374	32,603	27,057	7,156	70,190

There was then a down stream traffic amounting to something under 1½ lakh maunds per annum, and an up-stream traffic of about half this amount. These figures are borne out very closely by the result of enquiries made by Mr. Goodridge as to the number of boats employed in the trade, the freights carried by them, and the number of trips made by them.

Of the road traffic to Cuttack on one side, and to Raipur on the other, no statistics are available; but Mr. Goodridge's investigations indicate that the exports by road to Cuttack amount to about 75,000 maunds, consisting chiefly of sugar and oilseeds. The export to Raipur may be set down as 25,000 maunds, bringing up the total exports of the district by road and river to 2½ lakhs maunds.

9. But in addition to the traffic of the Sambalpur district a line of railway to Sambalpur might expect to catch some trade which now runs between the Raipur district and the Orissa coast *viâ* the Sambalpur district. This trade runs *viâ* Binka and does not now come to Sambalpur, though there can be very little doubt that it would be diverted to Sambalpur were Sambalpur in railway communication with the Chhattisgarh plain. The trade comes to Binka partly by river and partly by road, thence proceeds by road to Raipur *viâ* Sohela. It has been registered during the last two years with the following result:—

YEAR.	Rice.	Sugar.	Salt.	Cocoanuts.	All other commodities.	TOTAL.
	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.
			Towards	Raipur.		
1884-85 . . .	..	...	25,142	2,681	84,578	1,12,401
1885-86	...	...	40,352	7,369	3,946	51,667
			Towards	Cuttack.		
1884-85	4,627	168	...	...	22,998	27,793
1885-86	24,460	183	...	...	10,096	34,739

10. In discussing the commercial effect of the extension of railway communication to Sambalpur, a leading fact to be borne in mind is that a far more extended demand exists for Sambalpur produce on the west than on the east side of India. Rice and sugar are the typical products of Bengal and of Orissa, and to place Sambalpur in communication with those tracts is merely to offer facilities for the export of rice and sugar to places where they are already abundantly produced. On the other hand, the agricultural system of Western India and the Deccan is, speaking generally, characterized by the absence of rice and sugarcane cultivation, for which black soil is very unsuitable, and for which the rainfall is, as a rule, insufficient. A great deal of rice is of course grown in the Bombay coast districts, but the area under rice in these districts is small in relation to the total cropped area of Bombay and Berar, and accordingly the prices of rice as well as of sugar range much higher west than they range east of Nagpur.

One of the most striking results of the extension of railway communication to the Chhattisgarh plain has been the enormous increase in the export of rice from these Provinces to places in the Bombay Presidency and Berar.

The amount of rice exported from these Provinces during each of the last five years has been—

YEAR.	Mds.
1881-82	5,50,117
1882-83	9,95,365
1883-84	10,63,865
1884-85	12,83,019
1885-86	13,59,014

During 1881-82 the Nagpur and Chhattisgarh Railway was only open as far as Amgaon in the Bhandara district, and had not pierced the hills and forests which shut off the Chhattisgarh plain. During the next year the railway was completed to Nandgaon, its present terminus, and the increase in export is very striking. To the total amount of rice exported the contribution of Chhattisgarh, in each year since the railway reached it, has been as follows:—

	1883-84.	1884-85.	1885-86.
	Mds.	Mds.	Mds.
To Bombay Presidency	4,28,488	6,18,927	5,76,482
„ Berar	2,49,441	1,27,782	1,54,375
„ all other places	76,358	58,624	60,308
TOTAL .	7,54,287	8,05,333	7,91,165

The following figures give the average prices ruling for rice per maund of 40 seers in Sambalpur, Cuttack, Burdwan, Calcutta, Nagpur, Akola, and Dhulia (in Khandesh) at the end of April during the last ten years. The end of April is selected as being the period when trade is briskest. These prices are contrasted with the cost of carrying a maund of rice from Sambalpur to each of the other places named, and with the cost at which a maund of Sambalpur rice could be delivered at each of these places, were railway communication available :—

	Average price ruling at end of April during 10 years, 1877 to 1886.	Cost of carrying a maund by rail from Sambalpur.	Cost at which a maund of Sambalpur produce could be delivered by rail, *i.e.*, its price at Sambalpur *plus* freight.	Difference between this cost and average price at each place, *i.e.*, profit per maund exported.
	R a. p.	*R a. p.*	*R a. q.*	*R a. p.*
Sambalpur	1 7 0	......	......	......
Cuttack	2 1 2	0 9 2	2 0 2	0 1 0
Burdwan	2 2 1	0 9 7	2 0 7	0 1 6
Calcutta	3 0 5	0 11 5	2 2 5	0 14 0
Nagpur	2 14 10	0 11 5	2 2 5	0 12 5
Akola	4 10 0	0 15 7	2 6 7	2 3 5
Khandesh (Dhulia) . . .	3 14 9	*1 7 0	*2 14 0	1 0 9

* Including an allowance of R 0-2-9 per maund for carriage from Chalisgaon to Dhulia (34 miles.)

It will be observed that the profit on exports to either Cuttack or Burdwan would be very small. Calcutta offers a better opening owing to the exceptional demand of a large urban population, but the profit which would result from export to Nagpur (which would be equidistant with Calcutta from Sambalpur) would be almost as large, with the difference that the demand would not be limited by the consumption of a single town, but would be capable of great expansion for the supply of places in Berar and Khandesh. The large profit which these figures indicate on the export of rice from Sambalpur to Akola and Khandesh is very noticeable.

The extent to which the value of sugar in Western India exceeds its value in Eastern India is indicated by the following figures (taken from the table annexed to Government of India's Resolution No. 505A., dated May 30th, 1882) which give the average price of *gurh* in Bengal, in the Central Provinces, in Berar, and in the Bombay Presidency :—

	Bengal.	Central Provinces.	Berar.	Bombay Presidency.
	R a. p.	*R a. p.*	*R a. p.*	*R a. p.*
Price per maund of 40 seers .	4 10 0	6 5 0	9 8 0	6 7 0

It would appear then from these figures that Sambalpur has much more to hope for from a connection with Nagpur than from a connection with either Cuttack or Calcutta.

11. There is then a good deal to be urged in favour of making a branch line to Sambalpore a part of the project of the Nagpur-Bengal Railway, irrespective of any intention to carry the line on to Cuttack; and indeed, even were the project for a through line between Nagpur and Calcutta abandoned, there would still remain good reasons in favour of carrying on the line from Bilaspur to Sambalpur. A great portion of the country between Bilaspur and Sambalpur is no doubt very unproductive, but, as remarked above, some local traffic may be expected from the country lying along the left bank of the Mahanaddi if the line be aligned at no great distance from it. If the Nagpur-Bengal Railway be proceeded with, a branch line to Sambalpur would leave the main line at Panchpara and run down the valley of the Ib river. The country which the branch line would traverse, though not of such fertility as the central portion of the district, is still by no means destitute of possibilities. I am only acquainted with the southern portion of the Ib valley, which contains some very fine villages, and regarding the valley as a whole, I quote the words of Mr. Goodridge :— "The country on both banks of the Ib is open and well cultivated. That on the eastern side is principally a *rice* country of great fertility, and the accompanying sketch map will show what proportion of the total area is well cultivated, what proportion is fairly well cultivated, and what is either uncultivated or under forest. There are altogether about 200 villages on this side falling under the first class containing 130,000 acres, and 80 villages under the second class containing 7,000 acres. A reference to the settlement records shows that in these villages there are altogether about 30,000 acres of land of the first quality, 20,000 of the second, 65,000 of the third, and 85,000 of the fourth quality."

"The land on the west side of the Ib is perhaps even more fertile than that on the east bank, and is well watered. In nearly every village there are one or more large tanks which are used for irrigation purposes, and here a great deal of coarse sugar (*gurh*) is made. During a recent tour in this part of the district, I observed also in many places that spring crops were also being introduced and I saw in several villages some good wheat and gram-fields. The soil on the west bank, having more clay in it, and there being greater facilities here for constructing tanks, is better adapted for spring crops than the land on the east bank."

12. If, however, the construction of a branch line to Sambalpur will not be undertaken except as a portion of a line to Cuttack, I venture to represent the very great importance of carrying the line as near the town of Sambalpur as possible, as shown by the considerations already adduced. On this point Mr. Goodridge writes :—"The high lands surrounding the town of Sambalpur on the north do not permit of the railway being conveniently brought into the town of Sambalpur itself, and the best site for the station would probably be a couple of miles outside at a place named Sarla, but it would be well if arrangements could be made to unload boats into the railway wagons at all seasons of the year by providing a siding running down to the banks of the river at the Panch Kouria landing and ferry. The Executive Engineer, who has laid out the line to Sambalpur, informs me that there will be no difficulty in arranging for such a siding, which will be less expensive and more convenient than having the station itself at Sambalpur."

It is understood that for a railway to Cuttack two alternative routes have been surveyed—one running *viâ* Nakridol and Dhenkanal, and the other lying to the south *viâ* Rampur and Angol. Whether the line takes the northern or southern route it will on leaving the open country round Sambalpur "enter," writes Mr. Goodridge, "a hilly, thickly wooded, and sparsely cultivated tract not at first of much agricultural importance. The southern route *viâ* Rampur will doubtless render the railway more accessible to a small tract of open country lying to the south and east of the town of Sambalpur, but that area is, as shown on the accompanying map, comparatively insignificant, and would not, I apprehend, be considered of much importance in deciding the question one way or the other. On the other hand, the northern route would be more convenient to the Bamra State, which is rich in timber and iron and capable of great development."

But so long as the railway comes to Sambalpur it makes very little difference, so far as the district and the feudatory chiefships are concerned, what course it takes to Cuttack; and hence the alignment would seem to depend on purely engineering considerations.

Enclosure No. 17 to Railway Resolution No. 799 R. C. of 1887.

No. 424, dated Cuttack, the 27th February 1886.

From—C. T. METCALFE, ESQ., C.S.I., Commissioner of the Orissa Division,
To—The Chief Secretary to the Government of Bengal.

I have the honour, in reply to your letter No. 89A, dated the 9th of January 1886, to submit a report on the line of country between Sambalpur in the Central Provinces, and Cuttack, through which it is proposed that the Cuttack-Benares line of railway shall pass.

2. The proposed line, after leaving the Sambalpur district, passes through the State of Bamra, also under the Central Provinces Agency, and enters Talchir at Sapkata Hill, and runs for 30 miles parallel to the Government estate of Angul.

3. In the western part of the Talchir State, the country for miles is covered with scrub jungle intersected by numerous nullahs; scattered villages here and there are to be found, wretched in appearance, the people very poor. The Talchir estate generally is poor: the total area of cultivated land is estimated at 14,502 acres, and of jungle land 7,043 acres. The soil is hard and so stiff that iron crowbars are used in digging the earth in place of spades. The ground under the influence of the sun, even in the cold weather, binds and then splits, forming miniature crevasses. The iron bar is worked into these, and the earth removed in lumps. The State is small, containing only 116 villages in all—in the north-west, 105 villages; in the west, the direction the line will come, 7 villages; and in the south-west, 4.

4. The proposed line will pass near the Talchir coal-fields. I have no description of the value of the coal; but it was examined and reported on by Mr. Ball of the Geological Department. It is described to be as inferior; but the lower stratum has not been yet examined. The same coal-field extends to the Government estate of Angul.

5. The only possible exports from Talchir will be timber from the forests of the neighbouring State of Pal Lahera.

6. The population of the State is 35,590 as found at the census of 1881. There is very little trade of any kind: a little rice may be bartered in exchange for salt, sugar, and other necessaries of life.

7. There is no culturable waste land in the State. The scrub grows on a rocky soil not capable of cultivation; only in detached plots is the soil productive. These are marked by the presence of villages.

8. Facing Talchir on the south is the British territory of Angul, formerly one of the Gurjat States, but taken from its former chief, who was convicted of murder. The country has improved considerably under English administration. The people are exceedingly well to do, but far too proud to think of working on the roads, and too lazy to exert themselves beyond cultivating their fields. There is a considerable area of uncultivated land on scattered parts of the estate.

9. Coal exists along the banks of the Ouli river near Patrapara, six miles distant from Chendipara, through which the proposed line passes. I have no reports as to the quality of the coal; but the coal field extends for some distance—I should say over a square mile.

10. Rice, mustard, moong (a pulse), koolthi, a small pea, and oil-seeds are abundantly cultivated and exported. Angul feeds itself with paddy, but requires cotton-cloths, salt and spices.

11. The area of the estate is 563,840 acres, of which 259,797 are occupied by hills; of the remaining 304,083 acres, 51,022 were found cultivated at the last rough settlement. It is believed that 108,981 acres more have been reclaimed from waste and brought under cultivation, leaving 144,080 acres still capable of cultivation. Of this area, 71,295 are devoted to forest, leaving 72,785 for increase of cultivation.

12. After leaving Talchir, the line skirts the Hindol hills on the one side and the Brahmini river on the other, till it enters the State of Dhenkanal, the chief of which is a minor, the administration being under the Superintendent of the Tributary States. The country is in every way superior to Talchir and Hindol. The land is well wooded, the soil rich, the villages large and well populated, the scenery very pretty, high hills rise covered with dense vegetation, the green of which contrasts with the red soil below.

13. The chief produce is rice, of which there is little exported. The chief place is Dhenkanal; the residence of the chief is a long straggling village without trade or manufacture, but there are extensive forest lands in places, capable of cultivation. The character of the country is valleys with overhanging hills, the highest of which is Kapilas, 2,098 feet above mean sea-level.

14. The State is divided into two parts by the Brahmini river; the proposed line will pass through the southern portion, but the line will materially benefit the northern portion also, which abounds in iron, and where there is plenty of land available for extension of cultivation.

15. The line passes from Dhenkanal into the State of Athghar, a small state of 168 square miles, containing some 200 villages with a population of 2,600. The southern portion is very low and covered in floods by the spill of the Mahanaddi. It is proposed to carry the line through the low country in order to reach Naraj, a gorge through which the Mahanaddi passes, and across which it is proposed to carry the railway on its way to Puri. Scrub jungle on rocky soil with low intervening paddy-fields is the chief feature of the country. The branch to the station of Cuttack will pass along the northern bank of the river to a spot opposite the fort.

16. There is not much available land for increase of cultivation. There are no engineering difficulties along the whole route, large rivers to be crossed, or deep cuttings required. The difficulties arise when the Mahanaddi is reached. The line will pass through land which will probably be given free to the British Government for the Railway; but questions of jurisdiction over British subjects will arise which will require to be settled.

17. The evidence is against any large export or import trade except in oil-seeds from the States of Talchir, Dhenkanal, Athgar: from Angul rice and oil-seeds will be exported. A considerable local passenger traffic may also be expected from Sambalpur, Bamra, Pal Lehara, Athmallik, Talchir, Hindol, Dhenkanal, Athgar and Angul; but oil-seeds will form the chief export to Cuttack, while salt, sugar, shirtings, silks, spices, will be carried inwards. The line selected is the cheapest and the best that can be selected for joining Cuttack to Sambalpur, although a more direct line between Raipur and Puri could be found west of the Mahanaddi, avoiding the larger rivers, such as the Mahanaddi and the Katjori.

18. The Sambalpur and Cuttack line will pass through a country with a population of 335,917 persons, *viz.*:—

Pal Lehara	15,450
Dhenkanal	178,072
Talchir	38,021
Angul	78,374
Athgar	26,000
TOTAL	335,917

19. No statistics of the productive capabilities of the States or of the amount of the produce likely to be exported can be obtained. If compiled, the figures would be mere guess work. I have not therefore given any figures. The inhabitants of the Tributary States of Orissa through which the line will pass cannot be said to be energetic or alive to their material interests like their countrymen in Cuttack; they will allow the whole trade to be taken away from them by either European or Mahomedan merchants from Bombay. The Uriya has no energy, and is so apprehensive of sustaining loss that he would rather continue poor than hazard his capital in opening out the trade of his country. As regards trade, then, it will be developed very speedily by others than Uriyas: but as regards cultivation, the pressure of the population on land in Orissa will rapidly

convert the waste land into cultivated field wherever the nature of the soil will permit of it, and the undoubted effect of the railway will be to bring the waste lands of the Tributary States rapidly under cultivation.

20. In matters of cultivation the Uriyas cannot be charged with apathy or indifference; but it is in matters connected with trade that they are chargeable with indifference.

21. The present export trade of Cuttack depends mainly on the supply of grain from Sambalpur and the Central Provinces. I have no doubt that the railway will enormously develope this trade. The present route is by water, 200 miles by the Mahanaddi down stream, with a long and tedious return journey of 17 to 20 days. The carriage, under these circumstances, is expensive, besides being hazardous. A railway will largely develope this trade. The difference between the local selling price of grain and the market value at Cuttack is very large. I have known paddy selling at 70 seers for the rupee in the Gurjats, and the same quantity at the same time selling in Cuttack at 2 rupees, and I have no doubt that further into the interior the difference is even much larger.

22. I believe the development of trade will be enormous. It is only a few years ago that the value of export at False Point amounted to R12,71,575, while in the last year it had reached the sum of R26,49,195. When in addition to the present exports the vast stores of grain now cooped up in Central India are released, the traffic by rail must become very large.

Enclosure No. 18 to Railway Resolution No. 799R.C. of 1887.

Note left by MR. PARKER, Engineer-in-Chief, when going on furlough, 1886.

The object of the railway is to provide railway communication for pilgrims from Central and Western India visiting the shrine of Jaggannath at Puri. The railway will also open out the country between Sambalpur, Cuttack, and Puri, and it is supposed will materially facilitate and increase the trade of the three towns. As a famine relief work it will connect the districts of Orissa, periodically stricken with famine, with the rich grain-producing district of Chattisgarh, being connected with the Nagpur-Bengal Railway at Panchpara station, 3½ miles east of the Ib river.

2. The original project of the Benares-Cuttack Railway comprised a line from Mogul Serai station of the East Indian Railway, near Benares, to Chandil, a station on the Nagpur-Bengal Railway. From Chandil junction to Kantera on the Nagpur-Bengal Railway (ten miles north of Chaibassa, the sudder station of Singbhum) the traffic would have to be taken a distance of 28¾ miles over the Nagpur-Bengal line. From Kantera junction a length of 180 miles would bring the line to the north bank of the Mahanaddi.

3. From this station two alternatives existed—one for running the line up the north bank of the Mahanaddi, crossing that river at Naraj, and thence running in *viâ* Khurda to Puri, the other for establishing a ferry across the Mahanaddi at the terminus near the Beropa river, opposite Jobra, a suburb of Cuttack, and thence running a line across the Khukai river *viâ* Khurda to Puri. The comparative cost of these alternatives was given in the preliminary report and estimate on the line submitted by Mr. Parker in 1884.

4. A final estimate of the lines located from Mogul Serai to Chandil, from Kantera junction to the Beropa terminus, and from the south bank of the Khukai river to Puri, was submitted in 1885.

5. The section of the line between Kantera junction and the north bank of the Mahanaddi proved to be very expensive, amounting to R2,57,81,818, or R1,41,659 per mile on the 180 miles, the cost of this section being materially enhanced by the cost of a bridge required over the Brahmini river, and heavy ghât work at the descent from the Keunjhar plateau to the Orissa plains. The gradients were unfavourable, and the country traversed promised no results within any reasonable time that would warrant so expensive a line being made.

6. A reconnaissance was ordered by the Government of India, in the cold season 1884-85, of a line connecting Cuttack with the Nagpur-Bengal Railway near Panchpara, a village some 30 miles north of the town of Sambalpur and passing near to the town. The reconnaissance showed that a line could be constructed at a very much less cost than the Kantera-Cuttack section of the main line, Benares-Cuttack-Puri Railway, with more favourable gradients, and some prospects of a paying traffic, although this line would not serve passengers from the North-West of India, Benares and Gya. It would, however, be of material benefit to a very large number of pilgrims who visit Puri from Central and Western India.

7. The project to be submitted comprises therefore working plans and estimates for a railway from Panchpara to Naraj, crossing the Mahanaddi at Naraj, either by a ferry or by a permanent bridge, and joining the line located in 1884-85 from the south bank of the Khukai river to Puri, about three miles south of the Naraj bridge and four miles from the Katjori terminus, Cuttack-Puri section. To the amount of this estimate must be added the estimated cost of the Cuttack-Puri section, omitting the portion of the line between Katjori station and the junction.

8. It seems to me that the line now proposed might be connected with the Benares-Cuttack Railway at Sathbarwa in the Palamau district, by running a line northward from Panchpara up the valley of the Ib river as far as Amriha, a village in the Jashpur State, thence turning eastward *viâ* Kurdeg, Tainsar, Ramdega, Reidih to Gumla in the Panari pergunnah of Lohardugga. From Gumla the line would make for the pass near Saranga at the head of the Phuljar tributary of the north Koel river, run down the valley of the tributary and north Koel to Kuku in the Simah pergunnah, Palamau, cross a ridge, and join located line at Sathbarwa station.

9. There would be a rise of some 1,400 feet to Gumla, a further rise of 900 feet to the pass near Saranga, and a corresponding fall to Mankah, but the line would traverse a rich part of the Lohardugga plateau. No suggestion of this subject has yet been made to the Government, but I have myself traversed the country as far as Rehi, and the remainder has been levelled over by Mr. Concanon.

10. Should the Government of India entertain the idea, there would be a very large increase to the traffic of the Panchpara-Puri line, as pilgrims would make direct from Benares and Gya for Puri; and the section of main line, between Palamau and Mogulserai was shown in the estimate submitted for main line to be also the most favourable for construction as regards cost and prospects of the traffic.

11. The line from Panchpara to Puri would, besides the pilgrim traffic, attract a considerable traffic between Sambalpur and Cuttack. The Deputy Commissioner, Sambalpur, has been asked for an estimate of this traffic. The railway should be able to compete with the boats of Sambalpur and Cuttack. Some 2,000 boats are employed during the period the river is navigable. The navigation is difficult, and boats are occasionally lost. From Sambalpur to Katjori terminus is 144 miles: at ⅓ pie per maund per mile, lowest rate, the cost of carriage of one maund is 4 annas; but the boats charge 6 to 8 annas up from Cuttack and 8 to 12 annas down.

12. There would also be through traffic between Panchpara and Cuttack in a small way, as Talpachia, which is an important market, 1½ miles from Panchpara, supplies the country round about and the Native States to the north with goods from Cuttack, such as salt, piece-goods, brass vessels.

13. There would be also some local traffic, as hundreds of carts and bullocks from Cuttack traverse the country, being employed by banjaries and mahajuns, who purchase grain, jaggree, cotton, &c., in the different villages between Sambalpur and Cuttack.

14. From Panchpara to the 19th mile the line runs down the valley of the Ib river through an easy country, which is however much covered with jungle scrub and young sal trees. The only river of importance in this is the Bonun, which takes some 600 running feet of waterway.

15. Between the 19th and 20th mile passes through a gap in a range of hills running east and west and makes for Sambalpur: the site for railway station is about two miles from the bazar, but nearer approach cannot be made, as there is a mountain on the north-east of the city, to go round which would add three or four miles to the length of the railway, and the land and buildings interfered with would be costly. Sambalpur station is about the 31st mile from Panchpara, the country from the 19th mile being much the same as before.

16. After leaving Sambalpur the line runs through some five miles of open, but undulating ground, crossing two large streams, the Harrad and Maltijor nullahs. It then enters jungle and somewhat difficult ground to locate through, having to cross the watershed between the Brahmini and Mahanaddi rivers. This watershed is crossed at Kasinda, whence the line follows the valley of the Tikaria nullah to Kusala, 104th mile. The hills stand boldly up from the comparatively flat ground between them, rising from 1,000 to 1,500 feet above the general level of the country. A tributary of the Tikaria (an alternative trial line was run through the hills *viâ* Hero and Heraloi to Konchonpur, but as the summit was 110 feet higher than at Kasinda, this was abandoned in favour of Maltijor valley line, which has also better gradients) is crossed at Nakridol, requiring 100 running feet waterway, and the Ouli nullah at the 91st mile. Between Nakridol and Kusala several ridges are crossed which run from the hill south of the line down to the Tikaria nullah, having long gentle slopes, and the country is more than half covered with jungle. Kusala is a large village of 1,500 inhabitants. Mahajuns are established here, who trade with Cuttack.

17. From Kusala to Dhenkanal, 155th mile, the line traverses the Brahmini valley crossing one rather high ridge at the 117th mile, which extends some miles to the north-east. From Jarridoh, 118th mile, the valley is open and cultivated up to Bolpur. Three large nullahs—Sankria, Nongra and Bangursinga—are crossed. Coal shale crops out in the Sankria nullah, mile 111, and the trial pit was sunk 40 feet deep some years ago near the village Gopalprosad, ¼ mile from the railway, water being 10 feet only below the surface. No specimen could be obtained, but Superintendent of Geological Survey has been addressed on the subject.

18. Kadakpershad, a mile north of railway, mile 132, on the banks of the Brahmini, is an important village of some 1,000 houses, and 25 mahajuns reside here. Bolpur and

Dhenkhanal are large villages, the latter being the residence of the Chief of Dhenkhanal Tributary State. All round Dhenkhanal is a good deal of bamboo jungle, and from here to the river there is a length of some 12 miles of very dense jungle, scrub thorns, and bamboos. South of Dhenkhanal the line crosses again the dividing ridge of the Brahmini and Mahanaddi basins, passing between hills of laterite. The work is not heavy, and the gradients of 1 in 100 are not very long.

19. The line makes for a crossing of the river Mahanaddi at Naraj, 3,600 feet wide in full flood. There are low sandstone hills on either bank, but spill-water passes over the low land behind the hills on either side. On the north bank the spill-water appears to come from the large nulla that enters the river west of the Dawkoti hill. On the south side the river is embanked, but the embankment at Modilan, west of the Saidessen hill, is liable to be breached.

20. In the original project the line from Cuttack to Puri started from the bank of the Katjori river where the road to Khurda begins. The line now laid out joins this location four miles from this point, but as I understand from the Commissioner of Orissa that the Katjori terminus would not be workable for a ferry steamer in the rains owing to the fluctuation of the depth of water, a branch line has been located from near Hortikal to Sumliaband on the left bank of the Mahanaddi, opposite Cuttack fort to serve the town of Cuttack. The length of this is 8 miles, and a ferry steamer would be required to ply between the fort and Sumliaband. This station would also probably attract some of the pilgrims who travel by the Orissa Grand Trunk road to Puri.

21. Details of alignment and materials, &c., available for the line will be found in reports by Executive Engineer.

22. Permanent-way and English material would be landed at False Point and brought up to Cuttack by canal. Some might possibly be landed at Puri, but there is only an open roadstead there. I think it would be safest to land all English material at False Point, though it would be a convenience for the line south of the Mahanaddi to have a plate-laying head at Puri. There are workshops at Jobra where probably engines and wagons be set up, and for the Puri section it might be worthwhile to run a temporary line from Jobra to Naraj on the surface of the ground, crossing the Katjori by a temporary bridge, which would not cost much, as the river is fordable in the dry season.

Enclosure No. 19 to Railway Resolution No. 799R.E. of 1887.

Extract from the report by MR. T. OWEN, Officiating Engineer-in-Chief, Benares-Cuttack-Puri Railway Surveys on the line of railway from Panchpara on the Bengal-Nagpur State Railway to Cuttack.

3. The following statistics have been prepared showing the state of the water-borne trade at Sambalpur. There are about 2,000 large boats plying between Sambalpur and Cuttack, of an average carrying capacity of 250 maunds. Freight is at the rate of from 6 to 8 annas per maund on goods imported or coming up the river, and from 10 to 12 annas per maund for goods exported. About 4,50,000 maunds of rice, wheat, gram, tillee, horns, and about 500 bales of cotton, each of 3 maunds, worth about R25,000, are exported monthly and for six months of the year. In return 1¼ lakhs of maunds of salt, cloth worth R50,000, cocoanuts worth R3,000, and brass utensils worth R1,500, are also received monthly. In short, an estimate made by some of the leading merchants of the town puts the annual value of the exports at R12,00,000 and the imports at R13,00,000. The total value of the articles taxed for octroi entering the town at Sambalpur is alone R6,47,720. Thirty miles to the south on the river is Binka. It is the centre of the salt and cocoanut trade of the Raipur districts, it being nearer to Raipur than Sambalpur, the traffic to Raipur striking the eastern road at Sohella. The average exports and imports for a month are as follows :—

Exports.		*Imports.*	
Rice	16,500 maunds.	Salt . .	15,500 maunds.
Cotton . . .	330 „	Cocoanuts, valued at R 25,000.	
		Brass utensils, valued at R 2,000.	

Even supposing that the railway does not create any new trade, there is at present an export and import trade of not less than 25 lakhs of rupees annually between Sambalpur, Binka, and Cuttack, and considering the comparatively heavy rates for water carriage between Sambalpur and Cuttack, and still heavier cost for cart traffic, it is likely that the railway will be able to carry most of those articles much cheaper and all the year round instead of as at present for only eight months in the year. The journey to and back from Cuttack takes six weeks, and the boats at many places are subject to risk. Last year six large boats were lost. The traders of the town do not avail themselves of insurance.

4. The high lands surrounding the town of Sambalpur on the north do not permit of the railway being conveniently brought into the town of Sambalpur itself, and the best site for the station would probably be a couple of miles outside, at a place named Sorla, but it would be well if arrangements could be made to unload boats into the railway wagons at all seasons of the year by providing a siding running down to the banks of the river at the

Panchkauria landing and ferry. The Executive Engineer, who has laid out the line to Sambalpur, informs me that there will be no difficulty in arranging for such a siding, which will be less expensive and more convenient than having the station itself at Sambalpur.

5. So long as the railway comes to Sambalpur it does not matter, so far as the district and the feudatory states attached to it are concerned, what course it takes to Cuttack : therefore the shortest and easiest from an engineering point of view will probably be the best, and that selected by Mr. Parker from Sambalpur to Hiro and on to Nakridol seems a good one. Whether it take the northern or the southern road to Cuttack, it will in either case shortly enter a hilly, thickly wooded, and sparsely cultivated tract not at present of much economical importance.

The southern route *viâ* Rampur will doubtless render the railway more accessible to a small track of open country lying to the south and east of the town of Sambalpur, but that area is, as shown on the accompanying map, comparatively insignificant, and would not, I apprehend, be considered of much importance in deciding the question one way or the other. On the other hand, the northern route would be more convenient to the Bamra State, which is rich in timber and iron and is capable of great development.

6. I now proceed to give a brief sketch of the nature and productiveness of the country through which the line will run if it be brought from Panchpara to Samalpur till it reaches the hilly and sparsely cultivated country on the east of the district.

The country on both banks of the Ib is open and well cultivated. That on the eastern side is principally a rice country of great fertility, and the accompanying sketch will show what proportion of the total area is well cultivated, what portion is fairly well cultivated' and what is either uncultivated or under forest. There are altogether about 200 villages on this side falling under the first class, containing 130,000 acres, and 80 villages under the second class, containing 7,000 acres. A reference to settlement records shows that in these villages there are altogether about 30,000 acres of land of the first quality, 20,000 of the second, 65,000 of the third, and 85,000 of the fourth quality. The land on the west side of the Ib is perhaps even more fertile than that on the east bank, and is well watered. In nearly every village there are one or more large tanks which are used for irrigation purposes, and here a great deal of uncured sugar (*gur*) is made. During a recent tour in this part of the district I observed also in many places that spring crops are also being introduced, and I saw in several places some good wheat and gram fields. The soil on the west bank having more clay in it, and there being greater facilities here for constructing tanks, it is better adapted for spring crops than the land on the east bank.

7. In conclusion, I would add that there is every promise of a very considerable railway-borne trade between this district and Cuttack if a line to meet the Nagpur-Bengal Railway were constructed from Panchpara to Cuttack, and such a railway would also give an enormous stimulus to the water-borne trade of the whole Chhattisgarh country if brought to Sambalpur or some other point near by on the Mahanaddi.

Enclosure No. 20 to Railway Resolution No. 799R.E. of 1887.

No. 567, dated Hazaribagh, the 13th November 1886.

From—T. E. OWEN, Esq., Engr.-in-Chief, Benares-Cuttack-Puri Railway Surveys,

To—The Chief Engineer, Bengal, Public Works Department.

I have the honour to submit complete estimates and plans for a line of railway (broad gauge) from Panchpara *viâ* Sambalpur to Naraj, on the river Mahanaddi, with a branch line to Cuttack.

2. Panchpara is a station site on the proposed line from Sitarampur to Nagpur (124 miles from Sitarampur), within the district of Sambalpur, in the Central Provinces, and was fixed on as a suitable starting point for a line down the valley of the Ib and between the two great rivers Mahanaddi and Brahmini to open out Orissa and carry pilgrims to Puri, in place of another line located and estimated for from Chandil, a station on the proposed Nagpur-Bengal Railway, to Cuttack. A reconnaissance was made along this former line in 1884-85. The result being favourable, detailed estimates and plans were ordered to be prepared, and three survey parties were sent into the fields in November 1885, under the orders of Mr. Parker, Engineer-in-Chief, Benares-Cuttack-Puri Railway Surveys. Their field work was finished in April 1886.

3. This estimate is for a line 170 miles long from Panchpara to Naraj, a point on the Mahanaddi, fixed upon as the best site for crossing. Naraj is 8 miles higher up the river than Cuttack, and more in the direct route to Puri. It also provides for a branch line, 8¾ miles long, to Cuttack, leaving the main line at mile 166. The crossing of the Mahanaddi river either by ferry or bridge is not provided for in this estimate, which is a complete project in itself, and no steam ferry or bridge will be required unless a line of rail is carried on to Puri, and it is in the estimate for this latter that the cost of such is included. This estimate is submitted as a separate project with this office No. 560 of 10th November 1886. This line—Panchpara to Naraj—will bring Sambalpur, Chhattisgarh and the south-west inland portion of Orissa into communication with the lower navigable portion of the Maha-

naddi river, and with Cuttack and the Orissa canal system; the Mahanaddi river being navigable for a long way above Sambalpur into Chhattisgarh, but of little use for this purpose between Sambalpur and Naraj on account of rocks and rapids. The Talcher coal-fields will be opened out, and coal at a low rate can be supplied to Cuttack and the Orissa canal system. A reconnaissance by Mr. Parker in 1886 shews that this line can be continued up north to Palamau, and so on to Gya; this would then be the chief route for pilgrims to Puri.

4. The levels commence at a point on the Nagpur-Bengal Railway line, mile 124·106, in a slight cutting. The line runs chiefly through a country much cut up into ravines, with many small ranges and isolated groups of hills, and is undulating throughout. From 0 to mile 65 the line is a fairly easy one without heavy banks or cuttings, though the nature of the country necessitates frequent changes of grade. From mile 65 to 85 the cuttings and banks are rather heavy, with some long grades of 1 in 100. This could not be avoided, as explained in Executive Engineer's report, the line running between the river and some low hills. From mile 85 to 111 the line is fairly easy and light; miles 111 to 119 have rather long grades of 1 in 100; the rest of the line is fairly easy and without heavy cuttings or embankments, except in the last 3 miles, where there is a rather heavy bank on account of the spill of the river Mahanaddi. The branch line to Cuttack, 8¾ miles, leaves the main line at mile 166; the bank is high, the country being flooded between the junction and Cuttack. The height of bank here was so fixed by Mr. Parker. The maximum gradient is 1 in 100, and the minimum curve 1,910 feet radius for the whole line. In comparison with other lines through Chota-Nagpur and Orissa the banks and cuttings are not heavy, nor the gradients excessive. Except in miles 65 to 85, there are no long continuous grades up 1 in 100, which has been taken as the ruling gradient.

From Panchpara to the Mahanaddi the ascents amount to 1780·7. The descents amount to 2397·7, so that the difference is 617 feet. The minimum radius is 1,910, but there are only two short curves of this radius, all others being above 2,800.

5. There are no large rivers crossed, the largest stream is the Bonum, 8 spans of 100 feet; in the whole length there are only 16 major bridges, and none of these present any difficulty as to foundations.

6. From mile 0 to 42 the country is fairly cultivated.
" " 42 to 71 mostly waste and jungle.
" " 71 to 91 partially cultivated.
" " 91st to 103rd cultivated.
" " 103rd to 117th mostly waste and jungle.
" " 117th to 146th well cultivated.
" " 146th to 170th mostly jungle with stretches of cultivation here and there.

7. *Soil and material available.*—The soil is chiefly a sandy clay. To mile 132nd fairly good gneiss for building is to be had; at mile 166 there is sandstone, as well as at the terminus Naraj, where there is a good sandstone quarry much used. Earth suitable for brick-burning is to be had at intervals along the line, kunkur for lime is to be had along the whole length.

8. *Water.*—Little information is given about water. Where borings were made, rock was in most instances reached at from 5 to 10 feet. The inhabitants do not use well, but tank water.

9. *Coal and iron beds.*—The Talchir coal-fields are passed through; Gopalpersad, 110th mile, is about the centre of this. The coal beds are extensive, and probably could be cheaply worked, coal being near the surface. The quality is stated by Mr. Ball (Economic Geology) to be inferior, but from experiments carried on in Orissa it seems that useful coal is to be had. Mr. Medlicott reports on samples of Gopalpersad coal—"rather below the average of Indian coals, but still a fair fuel." Iron ore is reported to be found near miles 71 and 79.

Timber.—Sâl sleepers, it is reported, can be procured from the Bamra State, about mile 64, but probably the chief supplies would be from Forest depôts at Cuttack, and somewhere near Panchpara, and on the Brahmini river from the Keunjhar forests opposite miles 130 to 150. From this latter source it is probable a considerable saving on the estimated cost might be effected in prime cost and carriage.

10. *Traffic.*—No reliable statistics can be given on this point; the principal articles of import are cloth, thread, salt, tobacco, and metal utensils; and of export, grain, timber, bamboos, charcoal, and various jungle products. Sambalpur is the principal mart passed. The imports and exports here are—imports 6½ lakhs, exports 2¼ lakhs yearly; the latter chiefly consists of articles brought in under the head of import. A large trade may be expected here. The Deputy Commissioner reports the railway will tap the district of Chhatisgarh. The other places of most importance are Talpachia, 3½ miles, Supanga, 12th mile, Ranikinda, 24th mile, Nakridol, 71st mile, Chudipada, 96th mile, and Gopalpersad, 110th mile, and Dhenkhanal, 152nd mile, Cuttack terminus.

A considerable trade in timber might be expected. Coal would probably be carried down to Cuttack, over 60 miles of the line, in large quantities. More than half of the country passed through is cultivated, and most of the remainder is suitable for cultivation, and a railway would increase the value of this latter. The passenger traffic from the Central Provinces to Cuttack and Puri would probably be considerable, but there are no statistics.

The estimated cost of this project is 174 lakhs, interest at 8 per cent. = R12,92,000. This would require gross mileage receipt of R2,400 per day for goods and R1,140 per day for passengers, or nearly R95 per week per mile for goods and R45 per week per mile for passengers, to give an interest on the outlay of 4 per cent., allowing 50 per cent. for working, which, with cheap coal and sleepers for renewal, should be sufficient.

11. Three engine-changing stations will be required: one at each end and one near the middle. These have been fixed at Panchpara, 0 mile, at Ouli 91st mile, where bank is 0, and at Cuttack junction, mile 166; turntables being provided at Cuttack and Mahanaddi stations. At Ouli the ground is high and open, and this will be a good situation for quarters for the permanent staff. Cuttack junction station is some little way back from the actual junction of the branch, but there is no suitable site for a station nearer. It will probably be necessary to have a double line for this short distance.

As Panchpara will be a station on the Nagpur-Bengal Railway, no details are estimated for station arrangements. Lump sums have been entered sufficient for a share of each, or to provide separate accommodation, if necessary, under the heads of station buildings, staff quarters, and station machinery.

Second class stations with waiting-rooms have been provided for at Sambalpur, Cuttack junction, Cuttack, and Mahanaddi stations, and refreshment-rooms at Cuttack junction. These are a simple modification of the type plans for stations except at Cuttack junction, where the height of bank being 7 feet, a framed building resting on rails is provided. Passenger platforms 600 feet long and 40 feet wide are given.

The third class stations are on the ordinary type plan, with a platform length of 350 feet and a width of 40 feet. Watering arrangements are provided for at all stations except in some few a short distance apart.

Goods sheds 100 x 40 are provided for at all the second class stations, with platform 350 feet x 50 feet.

For the third class stations a goods platform has been provided for, 150 feet in length with shelter for goods 50 x 20 open in the front. These may not at all be required, and it may be convenient in many to place this structure on the passenger platform, where no separate goods platform is required. If there is the expected traffic in grain, &c., shelter from rain is most requisite, more or less, at every station in this district, with a heavy rainfall. This is a point frequently neglected. Plans of station yards show arrangements for crossing stations and extra sidings required in dotted blue. With a clear length of siding of 1,600 feet as laid down, a minimum length of 2,200 feet is required for station yards.

12. *Staff quarters.*—These have been provided for fully, terrace roofs on flat arches, and rolled beams have been given for all buildings, as far as possible, as suitable to the climate, and necessitating fewer repairs than any other description of roof. For dwelling-houses for the permanent superior staff, lump sums have been provided, the details of these being much better left to the Engineer in charge at time of construction.

Station machinery.—This has been fully provided for in all details.

13. *Rates.*—The rates for earthwork and masonry are those allowed by Mr. Parker in his estimates for lines from Mogul Serai to Puri, and I see no reason to alter them, as they appear amply sufficient. It is probable a considerable saving can be effected in construction by the use of rubble stone masonry for all minor bridges, foundations of major bridges and perhaps for superstructure of the latter, but all plans have been drawn out for brick masonry. Until construction commences it is uncertain how far rubble masonry could be used. Rates for other details have all been carefully gone into.

The permanent-way would be delivered at Cuttack up the Mahanaddi, opposite Naraj and at Panchpara by the Nagpur-Bengal line, if this latter is constructed first; and the, carriage has been estimated for accordingly—120 miles delivered from Cuttack, 50 miles delivered from Panchpara.

14. This work was under Mr. Parker as Engineer-in-Chief, with head-quarters at Hazaribagh, until 8th April 1886, when Mr. F. B. Walker took over charge, in addition to his other duties, with head-quarters at Bhagulpur. I took over charge from Mr. Walker on the 30th of June 1886, with head-quarters at Hazaribagh. The gradients were fixed before I took over charge. The plans of bridges, stations, quarters, &c., have been prepared since I took over charge, as well as all estimates.

Mr. F. L. Dibblee, Executive Engineer, 1st grade, with the following staff was in charge of the Sambalpur Division, miles 0 to 64:—Mr. E. C. Hawkes, temporary Engineer, and four surveyors.

Mr. C. Von Ahn, Executive Engineer, 3rd grade, with the following staff was in charge of the Centre Division, miles 64 to 111:—Mr. E. T. Faulkner, Assistant Engineer, 1st grade, and five surveyors.

Captain M. Laugharne, R.E., Executive Engineer, 3rd grade, with the following staff was in charge of the Cuttack Division, miles 111 to 170; the Cuttack Branch, 8 miles, and the junction (across the Mahanaddi river) with the Cuttack-Puri line, 3½ miles, until forenoon of 17th April 1886, when he took leave, and has not rejoined. Mr. Von Ahn took over charge of the Cuttack Division in addition to his own from the afternoon of 17th April 1886: Mr. E. J. Alexander, Assistant Engineer, 1st grade, and four surveyors.

The field work has been done quickly, and the alignment carefully laid out, and the survey plans and sections and land plans plotted and prepared neatly and with much detail. The original working plan and section sheets, together with land plans, details of earthwork and masonry, are kept with the records of each division. The centre line in miles 0 to 65 has been fixed on the ground by stone posts at every 10 chains fixed in a bed of concrete with exact centre of line marked on it, and the chainage on a stamped tin plate. From miles 65 to 170 and on the Cuttack branch and Naraj extension the centre line has been fixed at every 20 chains.

The following documents accompany this report:—

Estimates, main heads I to X.
„ Cuttack Branch, I to X.
Forms A to M, main line.
„ „ Cuttack branch.
Detailed estimates of quantities, main line.
„ „ Cuttack branch.
Executive Engineer's Reports.
1 General map of surveys made.
1 Portfolio Index plan and sections (12 sheets).
1 Ditto type plans, bridges, station yards and building . . . { Drawing Nos. 1 to 21. „ „ 38 to 47.
1 Ditto Major bridges . . . { Drawing Nos. 22 to 37. River sections, 15 sheets, and a type of 60 feet girders.
1 Ditto working plans and sections. Sambalpur ditto in 33 sheets.
1 Ditto ditto ditto. Centre division in 25 sheets.
1 Ditto ditto ditto, Cuttack Division in 30 sheets. And Cuttack branch in 5 sheets.

Report by Mr. F. L. DIBBLEE, M.I.C.E., Executive Engineer, upon the Sambalpur Division.

Alignment.—From Panchpara to Sambalpur the line runs almost due south; from thence to Ranga, the end of the division, the direction is nearly south-east, there being but a very slight divergence from a direct straight line between the two points. The obligatory points which fix the direction of the first part of the location are, 1st, the station of Panchpara where the junction with the Nagpur-Bengal-Railway is formed; 2nd, a suitable crossing of the Borun river at the 7th mile; 3rd, an opening in a range of low hills which crosses the country about the 20th mile; and 4th, the town of Sambalpur. Copy of a letter from the Deputy Commissioner of Sambalpur, in which he remarks on the question of taking the railway to that town, is appended. There was also a memorandum by the same officer regarding the route for the line generally, which was submitted and published with the Narrative Progress Report. The importance of making the town of Sambalpur a station on the main line rather than to have it served by a branch, having been recognised, the slight detour to take the line to that place became necessary, but the increase in distance is very little, as the opening above alluded to through the hills makes the same line obligatory up to the 24th mile in either case. The total length of railway to be built, as now arranged, will be slightly less than if a branch to Sambalpur had been decided on, and the only disadvantage is the carrying through traffic the short additional distance. From Sambalpur the general direction of the old Cuttack Road has been followed, excepting for a detour from the 42nd mile to mile 59 to avoid a high watershed near Heraloi, between the hills, by which the cart road passes. The highest point on the line adopted is 96 feet lower than that first tried.

Character of the country.—The country is open and well cultivated for the first 8 miles, the next 8 miles passes through jungle, with very small areas of cultivated land at long intervals. From this point, the 16th mile, to Sambalpur, the country is under cultivation for the whole distance, excepting at the point where the pass through the hills occurs. From Sambalpur, the 31st mile, to the 36th, the country is all cultivated; thence for three miles the line passes through jungle and broken ground, after which there are three miles of cultivated country; thence from the 42nd mile to the 64th the line passes through a long stretch of jungle with occasional cultivation near the widely scattered villages—one-fourth of this distance may be taken as cultivated and three-fourths jungle. It should be remarked that the whole country is quite suited for cultivation except where broken by hills and deep ravines, if there were inhabitants enough to occupy it. The country is generally tolerably flat, and there will be but few places where the limiting gradient of 1 in 100 has to be employed in any considerable lengths. There are three places where rock-cutting will be required of any appreciable depth, and in others laterite is met with in a few instances; but for all the rest of the division the material will be earth easily excavated.

Building material.—The general geological formation is metamorphic, with a small strip of carboniferous, which is crossed at mile 23. Gneiss of good workable quality is found at short intervals, and there are quarries now being worked of soapstone, which comes out in thin slabs, at mile 27 and at Sambalpur. Laterite is also found that may prove to be workable; nodulous kunker for lime is abundant everywhere. Good brick earth can in many places be obtained, and it will doubtless be economical to manufacture bricks for purposes of arching in culverts and for buildings.

Station sites.—Stations have been fixed for the 1st, 5th, 12th, 18th, 24th, 30th, 35th, 43rd, 53rd, and 61st miles. Many of these will not at first be required as contributing to the traffic of the line, but crossing places for trains and "line-clear messages," for working trains would necessitate the distances being kept nearly as has been proposed. A table is enclosed showing list of stations, with height of bank or cutting which occurs at each. Water is likely to be obtainable at all stations with moderate depth of well. It was found not to be possible to obtain accurate information on this point, however, as there are at present no existing wells in villages near our proposed stations. Water used by the people of the country appears to be almost universally obtained from tanks, where no stream exists. In the communication alluded to above, as having been received from Deputy Commissioner of Sambalpur, reference is made at some length to the importance of having a line of rails taken down to the river Mahanaddi at Sambalpur, so that goods might be transferred from boats to railway wagons direct, and it is pointed out that the traffic would be considerable. Such a line should, if made, be considered as an extension of goods sidings, and is quite practicable; but there might be difficulty in arranging a permanent landing place for boats which could be utilized at high as well as low water. This appears to be a question that could be dealt with more advantageously after the construction is completed, and when accurate observation could be made of the amount of goods traffic that would be served by it.

Labour.—All skilled labour will probably have to be imported, and, in the event of work being pushed vigorously, ordinary common labour for earthwork will also have to be imported. Wages are at present very low, and the importing even a part of the labour will increase them, and this doubtless will attract all the available labour at such time as it is free from the field work, but the population is not very great, and the work of cultivation when in progress would doubtless employ it all at certain seasons.

Markets.—The town of Sambalpur is probably the only one which can be considered large, and having a market which would give rise to any important traffic for the railway. The quantity and value of exports and imports have been furnished by the Deputy Commissioner, and is enumerated with his letter on the subject. The imports from all sources during the year 1884-85 are given as 9,88,000 maunds of R6,47,700 value, and the exports during the same period were 2,42,000 maunds and R2,26,000 in value. The village of Talpachia, about 3½ miles distant from Panchpara station, is to a certain extent a distributing centre of trade to and from the surrounding country, and will produce an appreciable amount of traffic. At Lopanga (12th mile from Panchpara) and at Ranikinda, 24th mile, there are weekly fairs, and doubtless when the railway traffic is established, articles of consumption will be imported and grain exported from these places. It is difficult to obtain any reliable statistics, as the custom in this part of the country is for the dealers to go about from the fair at one place to another without having shops of any sort. For the rest of the line, between Sambalpur and Ranja, there are no villages of any considerable size. The inhabitants appear to live in small hamlets, cluster of huts of no very great number. Doubtless trade centres will form to supply the wants of the people when the railway is established, and the carrying goods on bullocks' backs from one fair to another has come to an end.

River crossing.—A list of major bridges is attached showing the catchment area of country drained by each. The most important rivers are *first*, the Bonun; *second*, Hunad nullah; and *third*, the Matijor river. The first requires a bridge of 8 spans 100 feet girders; it drains 1,173 square miles; the banks are high, well defined, and rock appears on the surface of the riverbed for one-third the distance, and is found at no great depth for the remaining part of the bridge site. The second, Hunad nullah, is a branch of the Mahanaddi, and is crossed near Sambalpur by a bridge 3 spans of 80 feet. Rock appears in the bed of this also, and the foundation work will be inexpensive. The banks are well defined, but if the record of the highest floods is correct, there will be a considerable portion of flooded country on either side. The Matijor is crossed three times, the third crossing is at mile 34½, where drainage of 228 miles of country is provided by a bridge of 4 spans 60 feet each; the banks are high, rock appears on one side of the river, and the floods do not overflow the banks. The second Matijor crossing is at mile 46, where 3 spans of 60 feet are proposed;

the drainage area is 85 miles. The first crossing of this river is at mile 54, with a bridge of 1 in 100 feet span, rock foundations are found, and the banks are high, very much above flood level, and well defined. The other streams over which major bridges are required seem to call for no remark.

General.—The work of the survey was commenced on the 8th December 1885, and completed on the 10th March 1886. There was 100 miles of trial survey and 64 miles of completely located line finally staked out.

No. 867, dated Sambalpur, the 9th March 1886.

From—J. P. Goodridge, Esq., c.s., Offg. Deputy Commissioner, Sambalpur,
To—The Executive Engineer, Sambalpur Division, Benares-Cuttack-Puri Railway.

In compliance with your letter No. 73, dated 5th January 1886, I have the honour to forward in the form of a schedule what information I can readily collect regarding the trade of the town of Sambalpur. The main routes of traffic have been, for facility of reference, roughly indicated on the map attached to this letter, and the principle articles of export and import given against each—those in red ink indicate exports, and those in black ink imports. The river Mahanaddi is principally used in the trade with Cuttack and the Chhattisgarh country and other places on the east coast.

I would add that it is most essential that the railway should be brought to Sambalpur. The main difficulties of the navigation of the Mahanaddi occur between Sambalpur and Cuttack; and if the railway touched at Sambalpur, that town would be extensively used as an entrepôt for the produce of the whole of the Chhattisgarh country. Further, grain and other produce could be brought down in the rains at Sambalpur and stored there, and shipped to Cuttack at convenient times. A railway, therefore, from Sambalpur to Cuttack, would keep not only the country around Sambalpur in direct rapid communication with Cuttack and the eastern coast, but would open up the granaries of the extensive and fertile plain of Chhattisgarh, which is so rich in the production of cereals, silk, lac, and hides.

It would be most inconvenient for the trade if the railway did not touch the river at Sambalpur, as it would otherwise be necessary for the boats to undertake a short journey by land in a country where wheeled traffic is very rare and costly; grain, too, would be liable to serious damage during the rains in being transferred from boats to carts, and then to the railway. Moreover, in any case an expensive bridge and road will have to be made connecting Sambalpur with the railway, and it would perhaps be just as well to put Sambalpur at once in direct communication with the railway. The country, too, lying to the north and north-west of Sambalpur is also well populated and productive, and a considerable trade in rice and forest produce might be expected from the country situated in the Ib valley.

I would therefore strongly recommend that the line be brought down direct from Panchpara to the river at Sambalpur, and that at Sambalpur itself adequate arrangements be made off the banks of the river for boats to unload their cargoes direct into the railway wagon.

Report by Mr. C. Von. Ahn, Executive Engineer, on the Central Division.

1. *Alignment.*—This division joins the Sambalpur Division at the village of Ronja. From this point it runs approximately parallel to a low range of hills on the south, and the first two miles are fairly level. Beyond this, in the 67th mile, the line crosses a pass in the hills, running along the right bank of the Tikaria river. Some difficulty was experienced in obtaining a suitable alignment here, and curves of two degrees and three degrees' deflection per chain had to be adopted. The hills referred to jut right into the river with an almost vertical face towards the river, so that it was inadvisable to take the line along the river bank. After crossing this low range, the line runs between it and another higher range, until it crosses the Champali nullah. The ground here is very undulating, and the line passes over the spur of a hill just before crossing the Champali. This portion will require some rather heavy work, which from the nature of the country could not be avoided. At Nakridol the line crosses the Champali nullah, a tributary of the Tikaria river. This nullah will require a bridge of five spans of 40 feet. The foundations are on rock.

From Nakridol the line runs over fairly level ground as far as the village of Keloberani, passing the village of Saibi, where it is proposed to have a third-class station. There are a number of minor water-courses in this portion of the line. The drainage areas of these, however, are small, as they are crossed within a few miles of their sources. Several curves were required here, so as to avoid the spurs of hills lying to the south of the line.

From Keloberani to Totabari the line passes over very undulating ground, skirting several hills and crossing a number of minor water-courses. It is proposed to have a third-class station at Bindapur, where there is a fairly level piece of ground. The Gadgadi nullah is crossed in the 80th mile, near the village of Intosoro. This nullah will require a bridge of five spans of 40 feet. The foundations are on rock. The crossing is about half a mile below a rapid.

At Totabari there is a deflection to the south, so as to take the line over the narrowest portion of the sandstone ridge, in the 87th mile. Several trial lines were run over this portion of the line, and a number of cross sections were also taken. The alignment adopted proved to be the least expensive, although some rather heavy banking and cutting are required between Totabari and Chorimora.

From Chorimora there is a steady descent to the Ouli river, which is one of the main streams in this division. The crossing of this river was decided on after a careful survey including a number of cross sections, and the site was chosen independently by Mr. Parker and myself, near the village of Noapara. For most part the banks of this river are low, and the floods spread for a considerable distance on either side. The proposed site proved to be the only suitable crossing for some miles up and down stream. It is proposed to have a bridge here of six spans of 60 feet (girders). At Sorapal, on the right bank of the Ouli river, it is proposed to have a second-class and engine station called Ouli station.

After crossing the Ouli river the line runs over fairly level ground as far as the village of Purnagad, from which place there is an ascent of 1 in 100 extending for nearly a mile, beyond which the line again passes over fairly level ground as far as the village of Kusdi. This portion of the line passes within a short distance of the important villages of Bagadia and Chindipada, and runs through a well-cultivated district.

From Kusdi the line ascends for about one and a quarter mile with a gradient of 1 in 100, crossing a minor watershed near the village of Paljori, from which there is a steady descent to the Sandria river. The gradients, with the exception of about a mile at the end of this descent which is 1 in 100, are easy, averaging 1 in 200, and 1 in 250. There will be a third-class station in the 101st mile, named Kusdi station. From the 103rd mile to the Sandria river, the line runs close to a watershed for most of the way. The Sandria river is crossed in the 110th mile at a fairly long straight reach. This river will require a bridge of five spans of 60 feet. After crossing the Sandria the line goes straight to the village of Kuringa, where it joins the Cuttack division There is an ascent of 1 in 100 extending for about a mile. The banks and cuttings of this portion are rather heavy, averaging about 15 feet. There will be a third-class station at Kuringa.

2. *Character of country.*—From the village of Ronja to Nakridol (mile 64 to 71) the country is wild and uncultivated. From Nakridol to Ouli river (mile 91) there are patches of cultivation round the villages, with stretches of jungle intervening. The portion about Bagadia, Chindipad and as far as the village of Kusala is for the most part well cultivated. From Kusala to Gopalpershad there is a good deal of jungle, with patches of cultivation here and there. From Gopalpershad to Kuringa the line passes through a dense bamboo jungle.

The ground along the whole line is more or less undulating, and a great number of minor water-courses are crossed. For the first seven miles the soil is rocky, the remainder being chiefly sandy clay with portions of red laterite earth. At Totabari and between Gopalpershad and Kuringa, rocky soil is again met with.

In nearly all instances where borings were taken along the line, rock was obtained within 5 to 10 feet from the surface.

3. *Station sites.*—There are five stations in this division, and it is intended to have watering arrangements at each of them with the exception of Kusdi station. They are all third-class stations except the one at Ouli, which will be a second class and engine station. The sites have been chosen in the most populous and best cultivated localities. They are nearly all on level ground throughout. The following is a list of the stations, with the approximate height of banks and depth of water from surface :—

NAME OF STATION.	Miles.	Distance from last station.	Class.	Height of bank.	Approximate depth of water.	
Saibi	73¾	......	3rd	1′	5′	
Bindapur	81¼	7½	3rd	3′	5′	
Ouli	91	9¾	2nd	*Nil*	10′	**Engine station.**
Kusdi	100⅓	9⅓	3rd	1′	20′	
Kuringa	111	10⅔	3rd	4′	10′	

4. *Labour.*—There is no skilled labour, and unskilled labour is also scarce, so that it will be preferable to import suitable labour from a distance, specially as the natives of these parts are mostly unwilling to work. The ordinary daily wages for a cooly is two annas.

Traffic.—The traffic at present consists chiefly of salt, tobacco, and cloth goods brought from Cuttack, and in raw cotton and cereals taken to Cuttack. The means of conveyance is pack bullocks, the road being for the greater part unsuited for carts.

Building materials.—Sandstone is found in almost all portions of the line, and kankar suitable for line-burning is also obtainable. Stone for ballasting can be had everywhere within a sort distance of the line. Timber for sleepers could be obtained from the sâl forests of the Bamra State. There is also some sâl timber in the Radhakole State, through which the line passes.

5. *Markets.*—There are weekly markets at most of the important villages along the line. Bagadia is the largest village, and is the centre of an extensive grain-producing district. The villages next in importance are Nakridol, Chindipada, and Gopalpershad, which latter is the centre of the Talcher coal-field.

Minerals.—There is an extensive coal-field, the Talcher coal basin, whose centre is about the village of Gopalpershad. There was no time for taking borings but the Geological Department has sunk several shafts, and will be able to give all the necessary information regarding the quality of the coal. Iron is found at Nakridol and Intosoro.

6. *Major waterways.*—There are four major waterways on this section, *viz.*, the Champali, the Gadgadi, the Ouli, and the Sandria rivers.

The *Champali* is crossed in the 71st mile. It is a tributary of the Tikaria river and the crossing is about half a mile above the junction. It drains an area of 71 square miles. The fall of the bed is 7½ feet per mile. The channel is well defined, and the bed and banks are of rock. There will be a bridge here of 5 spans of 40 feet (girders).

The *Gadgadi* is crossed in the 80th mile. There are several rapids in this river. The crossing is about half a mile below the fall at Intosoro. The velocity at the crossing is about 10 feet per second. The bed is composed of solid sandstone. This river drains an area of 80 square miles. The bridge will consist of 5 spans of 40 feet (girders).

The *Ouli* is crossed in the 91st mile. The difficulty experienced in obtaining a suitable crossing has been already pointed out (see alignment). This river has a drainage area of 122 square miles. The left bank is low and the country flooded for some distance during heavy floods. There is a fall in the bed of 13½ feet per mile. The bed is composed of sand to a depth of ten feet. The bridge will consist of 6 spans of 60 feet (girders), the piers being on wells.

The *Sandria* is crossed in the 110th mile. The drainage area of this river is 98 square miles, and the fall of the bed 10 feet per mile. The bed is of sand overlying dead coal. The river overflows both banks during heavy floods. The channel is well defined. The bridge will consist of 5 spans of 60 feet (girders). Two piers will be on wells, and the others on concrete. All the above rivers are crossed on the square.

General.—The party, consisting of one Executive Engineer, one Assistant Engineer, one European and four native surveyors, left Hazaribagh about the beginning of November 1885 and arrived at Nakridol, from which place survey operations were to commence on the 4th of December. The trial lines it was proposed to run had been roughly decided on by Mr. Parker and myself, guided by the information obtained during the previous year's reconnaissance. The ground being for the most part hilly and covered with dense jungle, it was found necessary to take a number of cross sections. The country was also accurately surveyed for about half a mile on either side of the trial lines, which proved of great use during the location. By the 20th of January 1886 the trial line had been completed, and the location was roughly decided on.

Report by MR. C. VON AHN, Executive Engineer, upon the Cuttack Division, located by CAPTAIN LAUGHARNE, R.E.

1. *Alignment.*—The zero point of the division is at chain 10·95 of the Central Division near the village of Kuringa, about III miles from Panchpara. It was necessary here to give a curve of 30° deflection to the right in order to take the line over the lowest point of the Nathidi ridge. The line runs level for about a mile, when a short descent is required so as to reduce the bank over the Kuringa nullah, after crossing which the ascent to the Nathidi ridge commences. This ascent is about two miles in length, the greater portion having a gradient of 1 in 100. The summit of the hill is reached at mile 115; from this point the line begins at once to descend with a gradient of 1 in 100, extending for 2½ miles after which it lessens to 1 in 166. The line curves to the right to reduce the cutting in a small ridge running parallel to the main one, and then bends sharply to the left to enable a gradient of 1 in 100 to be obtained, as the ground falls very rapidly towards the Noondara nullah. This river is crossed in the 121st mile, and requires a bridge of four spans of 40 feet. After crossing this nullah the line again ascends for about a mile with a gradient of 1 in 166, and then passes over slightly undulating ground with easy gradients as far as the villige of Kadakpershad. This portion of the line runs mainly along a minor watershed, and considerable undulations are avoided, which would have interposed had the line been taken more to the north. The work is light and the drainage small. The gradients, except for a small portion, do not exceed 1 in 200. A third-class station will be given at Balrampershad, mile 122. This station will be on the direct road from Angul to Talcher being 14 miles distant from the former and 7 miles from the latter place. At mile 132, the Ningrajori nullah is crossed. The stream at the proposed crossing is much more confined than lower down. It does, however, overflow its banks during heavy floods, and it will be necessary to give some land arches to carry off the excess drainage. The

total requirements for this river are five spans of 60 feet (girders) and 6 arches of 20 feet, making a total of 420 lineal feet of waterway. The line now passes along the valley of the Brahmini river, and has been taken as near the hills to the south of this river as practicable, so as to be well above the flood level, care being taken to avoid passing through any of the numerous villages. The ground is slightly undulating, the gradients are easy, and there are long stretches of level, the total fall in 10 miles being only 30 feet. The Bangursinga nullah is crossed in the beginning of the 139th mile. The banks of this river are not well defined, and it spreads for some distance on either side during high floods. A bridge of one central span of 100 feet and four spans of 60 feet will be required here. There will be a third-class station at Haldiabahar in the 134th mile, and another at Gulundai in the 143rd mile. Both these stations are on level ground throughout and on the straight. For the next ten miles, *i. e.*, from Gulundai to Dhenkanal, the line passes over considerable undulations and the maximum gradient of 1 in 100 had to be resorted to, so as to keep down the amount of banking and cuttings, which averages only about 6 feet. There are several passes in this portion, and it was found that the alignment now adopted was preferable to the road alignment between Bolupura and Dhenkanal; being shorter and requiring less earthwork. The pass at Koria is an obligatory point, the line passing between the Koria hill on the south and a detached hill on the north. From this point to Dhenkanal the alignment is carried parallel with the existing road. It skirts the village of Dhenkanal on the north side, being kept as much as possible on the high ground near the village to afford a good position for the station site. Dhenkanal is the most important town between Cuttack and Sambalpur, and a number of baniahs reside at this place. From Dhenkanal there is a steady ascent of nearly two miles of 1 in 100 to the summit of the Dhenkanal pass, and the line then descends in gradients of 1 in 100 and 1 in 120 as far as the village of Bolabendo. From this point, as far as the village of Bobra, the ground is very undulating, and presented considerable difficulties in aligning. The hills which border the line on the north throw out many spurs which had to be avoided, but there are two which could not be easily circumvented, without throwing the line into too low ground near the village of Bobra. This portion of the line passes through very dense jungle It is intended to have a second class and engine station at Bobra, where there is a good stretch of level. This station will be about 2½ miles distant from the point where the Cuttack branch diverges from the main line, and it is intended to make it the Cuttack junction, there being no other suitable ground for a station in the vicinity. From Bobra the line curves to the south, to carry it to the lowest point of the next range of hills. This pass necessitates a rise of 1 in 100 for about a mile, and the line then again descends as far as the village of Hontikal, and thence passes over fairly level ground into the Mahanaddi bridge alignment. This latter part of the line is subject to floods from the spills of the Sapua, and a large amount of banking will therefore be required.

The crossing of the Mahanaddi river is determined by the position of the hills on either side of the stream, and lies between the confluence of the Sapua nullah with the Mahanaddi, and the divergence of the latter into its two branches,—the Mahanaddi and Katjori.

The connection of the right bank of the Mahanaddi with the Cuttack-Puri line presents no difficulties; the alignment has been kept close to the detached hills, so as to avoid heavy banks as much as possible. This portion is subject to spills from the Mahanaddi.

The branch line, which is intended to serve Cuttack, commences at mile 166 from Panchpara, and turning to the east runs along the left bank of the Mahanaddi to Simliaband, where the Cuttack station will be located. The line has been kept as near the foot of the hills as practicable, the ground being much flooded. Two curves were found necessary on this line to avoid some detached hills. The station site has been selected on the highest ground available, parallel to the river and just clear of the village. The line will be almost entirely in bank, there being only two short cuttings in the whole length of eight miles.

2. *Character of country and soil.*—From Kuringa up to the village of Jaruda, miles 111 to 117, the line passes chiefly through jungle. From this point along the valley of the Brahmini and as far as the village of Bolupora, mile 146, the country is well cultivated. Between Bolupora and Dhenkanal there is a good deal of jungle with patches of cultivation, and beyond Dhenkanal over the pass and as far as the village of Hontikal, mile 167, the line passes chiefly through jungle, with stretches of cultivation near the villages. The soil consists chiefly of clay along the whole line. Gneiss rock is met with on either side of the Ningrajori nullah. There are two outcrops of laterite between Bolabendo and Bobra, and the hill beyond Bobra, mile 166, is composed of sandstone. At Naraj there is a magnificent sandstone quarry.

3. *Station sites.*—There are seven stations in this division—six on the main line and one on the Cuttack branch. Each of these stations will have watering arrangements. Three of these stations will be second class, viz., the Cuttack junction (Bobra), the Mahanaddi, and the Cuttack stations. The remainder are all third-class stations. All the sta-

tions are on the level throughout. The following is a list of the stations, giving the approximate height of banks and depth of water from the surface :—

NAME OF STATION.	Mile.	Distance from last station.	Class.	Height of bank.	Approximate depth of water.	REMARKS.
		Miles.			Feet.	
Bulramprasad . . .	122	11	3rd	1 ft.	15	
Haldiabahar . . .	134	12	3rd	3 ft. cutting.	15	
Gulundai . . .	142¾	8¾	3rd	2 ft. „	20	
Dhenkanal . . .	152½	9¾	3rd	4 ft. bank.	10	
Bobra	163¼	10¾	2nd	4 ft.	15	Cuttack junction.
Mahanaddi . . .	169⅜	6⅛	2nd	4 ft.	......	
Cuttack* . . .	8 from the point where the line branches off from the main line.	10⅜	2nd	7 ft.	......	

* This station is about 10⅜ miles from the Cuttack junction and 174 miles from Panchpara.

4. *Labour.*—Very little skilled or unskilled labour will be obtainable in the district through which the line passes, so that most of the labour will have to be imported.

5. *Markets.*—There is a large bazar at Dhenkanal. There are also weekly markets at the more important villages along the line.

6. *Major waterways and sites of river crossings.*—There are three major waterways on this section, viz., the Nundara nullah, the Ningrajori nullah, and the Bangursinga nullah.

The Nundara nullah is crossed in the 121st mile. It drains an area of 52 square miles, and its bed falls 8½ feet per mile. The flood rises about 13 feet above bed level. This river is crossed on the square, and will require a bridge of 4 spans of 40 feet (girders). The foundations will be on rock, which is met within a few feet from the bed.

The Ningrajori nullah is crossed in the 132nd mile. It drains an area of 440 square miles, and has a fall of 5½ feet per mile in its bed. The flood rises 20 feet above bed level. The crossing is at right angles to a fairly long straight reach. This river will require a bridge of 5 spans of 60 feet (girders), and six arches of 20 feet to carry off spill water. The foundations of the main piers are on wells taken down to solid rock. The arch piers are on clay with inverts.

The Bangursinga nullah is crossed in the 139th mile. It drains an area of 134 square miles. The fall of bed per mile is 7 feet, and the flood rises 17 feet above bed. The crossing is on the square, and the banks are of stiff clay. This river will require a bridge of 1 span of 100 feet and 4 spans of 60 feet (girders). The foundations will be taken down to stiff clay.

Enclosure No. 21 to Railway Resolution No. 799 R. C. of 1887.

Estimate I.

MOGUL SERAI TO PALAMAU COAL-FIELDS, SUKHUA STATION.

147½ miles.

Items.	HEADS OF ESTIMATE.	Rate per mile.	Amount.	TOTAL.
		R	R	R
I	PRELIMINARY EXPENSES	1,117	1,64,758	1,64,758
II	LAND	2,348	3,46,298	3,46,298
III	CONSTRUCTION OF LINE—			
	(a) Earthwork	9,135	13,47,500	
	(b) Bridgework	30,929	45,62,019	
	(c) Fencing	2,000	2,95,000	
	(d) Level-crossings	248	36,608	
				62,41,127
IV	BALLAST AND PERMANENT-WAY—			
	(a) Ballast	5,740	8,46,650	
	(b) Sleepers	12,888	19,00,915	
	(c) Rails and fastenings	15,795	23,29,674	
				50,77,239
V	STATIONS AND BUILDINGS—			
	(a) Station Buildings	1,743	2,57,272	
	(b) Workshop and stores	1,500	2,21,250	
	(c) Staff quarters	4,178	6,16,137	
	(d) Station machinery	2,110	3,11,239	
				14,05,898
VI	PLANT—			
	(a) Engineering	1,157	1,70,657	
	(b) Locomotive	150	22,125	
	(c) Carriage and wagon	150	22,125	
	(d) Station and office furniture . . .	328	48,380	
				2,63,287
VII	ROLLING-STOCK	9,686	14,28,730	14,28,730
VIII	ESTABLISHMENT	8,973	13,23,532	13,23,532
IX	CONTINGENCIES	5,060	7,46,367	7,46,367
	Total for 147½ miles .	1,15,239		1,69,97,236
	Add—Indirect charges .	20,000	29,50,000	29,50,000
	GRAND TOTAL .	1,35,239		1,99,47,236

Enclosure No. 22 to Railway Resolution No. 799 R. C. of 1887.

Estimate II.

SUKHUA, MILE 147½, TO RUD, MILE 197½.

50 miles.

Items.	HEADS OF ESTIMATE.	Rate per mile.	Amount.	TOTAL.
		R	R	R
I*	PRELIMINARY EXPENSES	1,117	55,850	55,850
II	LAND	616	30,819	30,819
III	CONSTRUCTION OF LINE—			
	(*a*) Earthwork	12,687	6,34,338	
	(*b*) Bridgework	14,899	7,44,957	
	(*c*) Fencing	2,000	1,00,000	
	*(*d*) Level-crossings	250	12,500	14,91,795
IV	BALLAST AND PERMANENT-WAY—			
	(*a*) Ballast	4,737	2,36,850	
	(*b*) Sleepers	9,391	4,69,586	
	(*c*) Rails and fastenings	15,829	7,91,467	14,97,903
V*	STATIONS AND BUILDINGS—			
	(*a*) Station buildings	1,705	85,250	
	(*b*) Workshop and stores	2,000	1,00,000	
	(*c*) Staff quarters	3,705	1,85,250	
	(*d*) Station machinery	1,785	89,250	4,59,750
VI*	PLANT—			
	(*a*) Engineering	1,157	57,850	
	(*b*) Locomotive	150	7,500	
	(*c*) Carriage and wagon	150	7,500	
	(*d*) Station and office furniture	328	16,400	89,250
VII*	ROLLING-STOCK	9,666	4,83,300	4,83,300
VIII	ESTABLISHMENT	7,072	3,53,612	3,53,612
IX	CONTINGENCIES	4,108	2,05,433	2,05,433
	Total for 50 miles	93,354		46,67,712
	Add—Indirect charges	20,000		10,00,000
	GRAND TOTAL	1,13,354		56,67,712

NOTE.—Items marked * taken at rate per mile, adapted for Northern Section valley alternative.

Enclosure No. 23 to Railway Resolution No. 799 R. C. of 1887.

Estimate III.

RUD *via* DAMUDA VALLEY TO CHANDIL.

127 miles.

Items.	HEADS OF ESTIMATE.	Rate per mile.	Amount.	TOTAL.
		R	R	R
I	PRELIMINARY EXPENSES	1,117	1,41,859	1,41,859
II	LAND	1,265	1,60,717	1,60,717
III	CONSTRUCTION OF LINE—			
	(*a*) Earthwork	18,599	23,62,067	
	(*b*) Bridgework	21,106	26,80,441	
	(*c*) Fencing	2,000	2,54,000	
	(*d*) Level-crossings	217	27,576	53,24,084
IV	BALLAST AND PERMANENT-WAY—			
	(*a*) Ballast	5,346	6,78,949	
	(*b*) Sleepers	9,386	11,91,980	
	(*c*) Rails and fastenings	14,479	18,38,721	37,09,650
V	STATIONS AND BUILDINGS—			
	(*a*) Station buildings	1,806	2,29,286	
	(*b*) Workshop and stores	2,000	2,54,000	
	(*c*) Staff quarters	3,863	4,90,589	
	(*d*) Station machinery	1,902	2,41,562	12,15,437
VI	PLANT—			
	(*a*) Engineering	1,157	1,46,939	
	(*b*) Locomotive	150	19,050	
	(*c*) Carriage and wagon	150	19,050	
	(*d*) Station and office furniture	328	41,656	2,26,695
VII	ROLLING-STOCK	9,666	12,27,582	12,27,582
VIII	ESTABLISHMENT	8,308	10,55,175	10,55,175
IX	CONTINGENCIES	4,727	6,00,301	6,00,301
	Total for 127 miles	1,07,572		1,36,61,500
	Add—Indirect charges	20,000		25,40,000
	GRAND TOTAL	1,27,572		1,62,01,500

Enclosure No. 24 to Railway Resolution No. 799 R. C. of 1887.

Estimate IV.

RUD, MILE 197½, TO MILE 275, JUNCTION OF PURULIA BRANCH.

77½ miles.

Items.	HEADS OF ESTIMATE.	Rate per mile.	Amount.	TOTAL.
		R	R	R
I	PRELIMINARY EXPENSES	1,117	86,567	86,567
II	LAND	1,265	98,038	98,038
III	CONSTRUCTION OF LINE—			
	(*a*) Earthwork	18,599	14,41,422	
	(*b*) Bridgework	22,564	17,48,694	
	(*c*) Fencing	2,000	1,55,000	
	(*d*) Level crossings	217	16,818	33,61,934
IV	BALLAST AND PERMANENT-WAY			
	(*a*) Ballast	5,346	4,14,315	
	(*b*) Sleepers	9,636	7,46,736	
	(*c*) Rails and fastenings	13,097	10,15,035	21,76,086
V	STATIONS AND BUILDINGS—			
	(*a*) Station buildings	1,806	1,39,965	
	(*b*) Workshop and stores	2,000	1,55,000	
	(*c*) Staff quarters	3,863	2,99,383	
	(*d*) Station machinery	1,902	1,47,405	7,41,753
VI	PLANT—			
	(*a*) Engineering	1,157	89,668	
	(*b*) Locomotive	150	11,625	
	(*c*) Carriage and wagon	158	11,625	
	(*d*) Station and office furniture	328	25,420	1,38,338
VII	ROLLING-STOCK	9,666	7,49,115	7,49,115
VIII	ESTABLISHMENT	8,341	6,46,438	6,46,438
IX	CONTINGENCIES	4,743	3,67,592	3,67,592
	Total for 77½ miles	1,07,947	......	83,65,861
	Add—Indirect charges	20,000	......	15,50,000
	GRAND TOTAL	1,27,947	......	99,15,861

Enclosure No. 25 to Railway Resolution No. 799 R. C. of 1887.

Estimate V.

BRANCH FROM MILE 275 (VALLEY ALTERNATIVE) TO PURULIA.

33 miles.

Items.	HEADS OF ESTIMATE.	Rate per mile.	Amount.	TOTAL.
		R	R	R
I	PRELIMINARY EXPENSES	1,200	39,600	39,600
II	LAND	2,000	66,000	66,000
III	CONSTRUCTION OF LINE—			
	(*a*) Earthwork	20,329	6,70,857	
	(*b*) Bridgework	10,163	3,35,379	
	(*c*) Fencing	2,160	71,280	
	(*d*) Level crossings	260	8 580	10,86,096
IV	BALLAST AND PERMANENT-WAY—			
	(*a*) Ballast	5,430	1,79,190	
	(*b*) Sleepers	10,130	3,34,290	
	(*c*) Rails and fastenings	13,924	4,59,492	9,72,972
V	STATIONS AND BUILDINGS—			
	(*a*) Station buildings	2,012	66,396	
	(*b*) Workshop and stores	1,500	49,500	
	(*c*) Staff quarters	3,704	1,22,232	
	(*d*) Station machinery	1,784	58 872	2,97,000
VI	PLANT	1,800	......	59,400
VII	ROLLING-STOCK	10,000	......	3,30,000
VIII	ESTABLISHMENT AT 10 PER CENT., I TO V	......	......	2,46,167
IX	CONTINGENCIES AT 5 PER CENT., I TO VII	......	......	1,42,553
	Total direct charges	......	......	32,39,788
	Capitalized abatement of land revenue	......	655	
	Loss by exchange, at 1*s.* 7*d.*	......	1,79,505	
	Leave and pension allowances	......	49,213	
	Interest during construction	......	2,18,820	
	Total Indirect charges	......	......	4,48,193
	GRAND TOTAL FOR 33 MILES	1,11,757	......	36,87,981

Enclosure No. 26 to Railway Resolution No. 799 R. C. of 1887.

Estimate VI.

GYA TO SUKHUA.

80 miles.

Items.	HEADS OF ESTIMATE.	Rate per mile.	Amount.	Total.
		R	R	R
I	PRELIMINARY EXPENSES	824	65,918	65,918
II	LAND	1,286	1,02,857	1,02,857
III	CONSTRUCTION OF LINE—			
	(*a*) Earthwork	8,145	6,51,668	
	(*b*) Bridgework	11,048	8,83,862	
	(*c*) Level crossings	291	23,312	
	(*d*) Fencing	2,023	1,61,840	17,20,682
IV	BALLAST AND PERMANENT-WAY—			
	(*a*) Ballast	5,367	4,29,360	
	(*b*) Sleepers	13,980	11,18,400	
	(*c*) Rails and fastenings	15,312	12,24,916	27,72,676
V	STATIONS AND BUILDINGS—			
	(*a*) Station buildings	1,309	1,04,733	
	(*b*) Workshop and stores	1,500	1,20,000	
	(*c*) Staff quarters	2,828	2,26,285	
	(*d*) Station machinery	1,274	1,01,913	5,52,931
VI	PLANT—			
	(*a*) Engineering	950	76,000	
	(*b*) Locomotive	150	12,000	
	(*c*) Carriage and wagon	150	12,000	
	(*d*) Station and office furniture	250	20,000	1,20,000
VII	ROLLING-STOCK	9,033	7,22,640	7,22,640
VIII	ESTABLISHMENT	6,519	5,21,506	5,21,506
IX	CONTINGENCIES	3,786	3,02,885	3,02,885
	Total for 80 miles	86,026		68,82,095
	Add—Indirect charges	14,350		11,48,000
	GRAND TOTAL	1,00,376		80,30,095

Enclosure No. 28 to Railway Resolution No. 799 R. C. of 1887.

Estimate VII.

PANCHPARA TO NARAJ.

170 miles.

Items.	HEADS OF ESTIMATE.	Rate per mile.	Amount.	Total.
		R	R	R
I	PRELIMINARY EXPENSES	1,048·6	1,78,262	1,78,262
II	LAND	631	1,07,288	1,07,288
III	CONSTRUCTION OF LINE—			
	(*a*) Earthwork	10,589	18,00,187	
	(*b*) Bridgework, major	12,409	7,98,460	
	Ditto, minor		13,11,097	
	(*c*) Fencing	3,400	5,78,000	
	(*d*) Level-crossings	220	37,438	
	(*e*) Miles and gradient posts	35	5,950	
	(*f*) Temporary quarters	882	1,50,000	46,81,082
IV	BALLAST AND PERMANENT-WAY—			
	(*a*) Ballast	5,963	10,13,710	
	(*b*) Sleepers	9,325·25	15,85,293	
	(*c*) Rails and fastenings	10,775	18,31,720	44,30,723
V	STATIONS AND BUILDINGS—			
	(*a*) Station building	2,445	4,15,561	
	(*b*) Workshop and stores	1,500	2,55,000	
	(*c*) Staff quarters	2,775	4,71,732	
	(*d*) Station machinery	1,812	3,08,121	14,50,414
VI	PLANT—			
	(*a*) Engineering	885	1,50,488	
	(*b*) Locomotive	150	25,500	
	(*c*) Carriage and wagon	150	25,500	
	(*d*) Station and office furniture	329	55,990	2,57,478
VII	ROLLING-STOCK	9,390	15,96,200	15,96,200
VIII	ESTABLISHMENT	6,841	11,62,891	11,62,891
IX	CONTINGENCIES	4,025	6,84,304	6,84,304
X	MAINTENANCE	20	34,000	34,000
	Total for 170 miles	85,780		1,45,82,642
	Add—Indirect charges	11,683	19,86,149	19,86,149
	GRAND TOTAL	97,463		1,65,68,791